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A work-conference project which attempted to explore the possibilities of a theoretical basis for research in the new educational media is documented in this report. The background for the Conference on Theory for the New Media in Education is summarized in terms of papers circulated prior to the conference. The five conference working papers are extensions of these and deal with the structure and function of scientific theories; with the relevance of learning-behavior theory, communication theory, and social theory to the new media; and with the implications of theory for research and implementation. The first of two conference presentations analyze the micromolar approach to education, with particular attention to the learning of response speed. The second presentation suggests that although the conference objectives were practically oriented, theory development is needed for hypothesis production. The report concludes with the evaluative comments of seven groups of conference participants. The appendices include various documents used by the conference. (RP)

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Theory for the New Media in Education

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Theory for the New Media in Education

Proceedings of a Work Conference
to Study the Role of Scientific Theory
in Developing and Applying Research
on the New Media in Education

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Theory for the New Media in Education

Final Report of U.S.O.E. Contract Project #SAE-9287

entitled

A REGIONAL WORK CONFERENCE
TO DEVELOP A THEORETICAL FRAMEWORK
FOR NEW MEDIA RESEARCH AND APPLICATION

Project Director: John M. Parsey, Associate Professor
College of Education
Michigan State University

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August 1968

iv/v

Foreword

This five-part report brings together, for the first time, all of the subject matter of the exploration phases of a work-conference project which attempted: (1) to explore the problems and potentials of a theoretical base for research and application in the new educational media, and (2) to experiment with a conference designed "to do well that which a conference does best." The experimentation aspects of the project are being reported in a companion volume, Anatomy of a Conference.

The content of this report, in a variety of forms, was widely circulated during the three years following the termination of the project. These early printings reached an audience which extended considerably beyond the field of the "new educational media." In particular, the Conference working papers (Part II) received the widest circulation. More limited circulation was enjoyed by the "later" products of the project: the Conference presentations (Part III), and the work-discussion group reports (Part IV).

All of these materials have been out of print for almost two years. Numerous and continuing inquiries attest to an active interest in their approach and content. The present report, then, makes them available in a single volume designed and organized to facilitate their potential usefulness.

Part I reviews the historical background of the New Media Theory Conference project, and summarizes significant elements of the pre-Conference working papers (Part II), the Conference presentations (Part III), and the reports of the work-discussion groups (Part IV).

Part II presents the working papers prepared for pre-Conference study and reaction by participants. This feedback was intended to provide a major basis for developing the Conference presentations.

Part III contains two of the five Conference presentations. It indexes (in part) the extent to which it was possible: (1) to concentrate the Conference on "doing the things which conferences do best," and (2) to demonstrate effective use of the new media. In sum, three of the five Conference presentations focused largely on explications of selected aspects of the working papers and are therefore not included in the present volume.

Part IV presents the formal reports of the Theory Conference work-study-discussion groups. This content has received the most limited circulation to date, and contains perhaps the most creative interpretations and approaches to the exploration and experimentation aspects of the project.

Part V, the appendix, provides the documentation, the illustrations and explanations, of the project as a whole.

Finally, the less tangible application potentials of this report deserve some emphasis. It is suggested that the report carries a variety of research and application potentials for people concerned with human behavior--in general, or as mediated by the "new educational media." Thus, for the teacher and the new media specialist, it suggests applications ranging from frameworks and methods for organizing professional knowledge to teaching-learning principles and techniques useful in a variety of practical situations. For research workers, it outlines the beginnings of a philosophy of research and provides many insights into the strengths and limitations of research method. It also yields a near infinity of problems for research. For the educational and new media administrator, it suggests structures, approaches, and processes which promise to faciliate productive research and effective application of research results.

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August 1968

Acknowledgements

It is always difficult to identify, and to acknowledge in appropriate ways, the contributions which are made to a cooperative project. The task becomes even more difficult when the cooperative project extends over a period of time, and involves many people in many ways. When the end product of the combined efforts is as enigmatic as a manuscript, the task becomes very difficult indeed. At the same time, the inscrutability of the end product combines with the principles of simple justice to demand that the task be undertaken.

The idea of the New Media Theory Conference project began to take shape during a Regional Planning Conference held at Michigan State University in April 1960. Grateful acknowledgement for institutional support and sponsorship of this initial phase is extended to the New Media Branch, United States Office of Education, Department of Health, Education, and Welfare; and to the College of Education and the Continuing Education Service, Michigan State University. Sincere appreciation for individual contributions is also extended to these persons: representatives of educational institutions and agencies who contributed to the original pool of ideas; members of the Michigan State University Planning Committee who developed the design of the Regional Conference; and to the Michigan State University faculty members who served as resource people at this initial meeting. All of these people are identified in Appendix F.

Appreciative acknowledgement of institutional support for the New Media Theory Conference itself is extended to the New Media Branch, United States Office of Education, Department of Health, Education, and Welfare, which supported the project under a contract written under Title VII, Part B, National Defense Education Act. Sincere thanks are also extended to the Michigan State University sponsors: the College of Communication Arts, the College of Education, and the Continuing Education Service.

On an individual basis, the contributions of these groups are acknowledged, and a verbal token of sincere appreciation is extended: to the members of the Michigan State University Theory Conference Committee who gave generously of their time and talent for an unconscionable period of time; to the members of the Regional Advisory Committee whose efforts often overcame the handicaps of distance; to the resource people whose critically important contributions were always of the highest quality, and whose participation in the Theory Conference proceedings did much to establish its stimulating atmosphere and to assure its success; and to the regional and campus conferees whose fulfillment of before-the-event commitments went much beyond optimistic expectations, and whose participation in the Conference was always genuine and stimulating, and whose responses to the follow-up were both prompt and highly adequate. All of these people are identified in appropriate sections of Appendix F.

The more visible aspects of any conference suggest, but they do not begin to index adequately, the amount of invisible effort that goes into making the invisible parts effectively visible. Scarcely adequate, but quite sincere and visible, appreciation for contributions of this kind is extended to these people: Mrs. Diane Johnson, Mrs. Shirley Monczka, and Mrs. Sharon Anthes for the cheerful and efficient energy with which they converted bewlidering miscellanies of materials into neat arrays of letters to be mailed and copy to be printed; to Mr. Kyale Mwendwa and Mr. Henry Milanowski for their assistance in carrying out the project; to Mrs. Roslyn Blum and Mr. John Delonas for the effective sensitivity with which they applied their editorial talents to the Theory Conference materials; to Dr. Tunis Dekker and Miss Mary Carewe of the Continuing Education Service who contributed so much to the dynamics of Conference operation; to Dr. James Tintera of the College of Education and Mr. Wilfrid Veenendaal and Mr. Archie Watson of the Audiovisual Center, whose professional talents and service contributed so directly to converting the new media dimensions of the Conference from a theoretical abstraction to an effective demonstration of practice-what-you-preach reality; and to Mr. Howard Grider and

Mr. Gerald Bush of the Michigan State University Business Office, whose efficient handling of the fiscal aspects of the project pleasantly surprised the representatives from other institutions and agencies--and established satisfying-to-contemplate precedents for the future.

Finally, in the preparation of this report, appreciative acknowledgement is extended to the authors, publishers, and publications whose works are quoted or paraphrased herein. Although it is scarcely possible to recognize every individual contribution of this kind, a sincere effort to do so is reflected in the bibliographies and footnotes given throughout the report. More specifically, formal permission to reproduce the figures given in Part II of the report is gratefully acknowledged. In each case, the bibliographical details are indicated in the source references which follow the titles of the figures in question.

Contents

Part/Section Page

Foreword v
Acknowledgements vii

Part I: Overview and Summary 1

Overview: Development of the Theory Conference. . . 3
Summary: Pre-Conference Working Papers. 8
Summary: Work-Conference Presentations. 15
Summary: Work-Discussion Group Reports 19

Part II: Working Papers for the New Media Theory Conference 27

Structure and Function of Scientific Theories 29
Learning-Behavior Theory and Education 59
Communication Theory and the Use of the New Media . 89
Social Theory and the New Media 125
Implications of Theory for Research and Implementation in the New Educational Media . . 143

Part III: Presentations at the New Media Theory Conference 169

A Micromolar Approach to Education and the New Media 171
Toward the Reduction of a Difference-Signal. 189

Part/Section CONTENTS Page

Part IV: Reports of the Work-Discussion Groups 239

Report of Work Group A 241
Report of Work Group B 249
Report of Work Group C 257
Report of Work Group D 261
Report of Work Group E 271
Report of Work Group F 281
Report of Work Group G 289

Part V: Appendixes 297

A. Regional Planning Conference 299
B. Theory for the New Media 303
C. Conference on Theory for the New Media in Education. 313
D. Working Papers on Theory in the New Media 325
E. Conference Working Documents 341
F. Participants in the Theory Conference Project. . . . 361

Part I

Overview and Summary

Overview: Development of the Theory Conference 3

Summary: Pre-Conference Working Papers 8

Summary: Work-Conference Presentations 15

Summary: Work-Discussion Group Reports 19

Overview and Summary

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Overview: Development of the Theory Conference

Regional Planning Conference

The development of the New Media Theory Conference began with a Regional Planning Conference attended by representatives of educational, research, and related agencies from seven midwestern states: Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio, and Wisconsin. To maximize multiple representation, most of the participants represented one or more of the regional institutions, organizations, agencies, and/or professional associations which were concerned with new media research and application. The major fields represented included: new media and related research; public schools, colleges, and universities; professional education and new media associations; and practitioners and administrators identified with education and with the new media.[1]

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[1] The Regional Planning Conference participants are identified in Appendix F, Section 1. The Michigan State University Planning Conference resource people and the Planning Conference Committee members are named in Appendix F, Sections 2 and 3, respectively.

The general purpose of the Regional Planning Conference was to consider ways of strengthening the research and dissemination aspects of the new educational media program being developed by the United States Office of Education under the National Defense Education Act. The participants offered five general recommendations on the nature of the follow-up venture (if any): (1) the general purpose of any follow-up should be to strengthen the research dimension of the new educational media research and application program, (2) the conference[2] method could be used to achieve the purpose projected, (3) highest content priority ought to be given to the development/analysis of a theoretical/conceptual framework for new media research, (4) a major effort should be made to involve active research workers in the new media and in related social and psychological fields, and (5) the participant representation should be primarily regional.[3]

Theory Conference Proposal

The approach outlined at the Regional Planning Conference became the basis of a project proposal developed by the Michigan State University Planning Conference Committee.[4] The formal proposal was submitted to the United States Office of Education under the title, "Regional Work Conference to Explore the Problems and Potentials of a Theoretical Framework for Conducting Research and Applying the Results of This Research on the New Media in Education."[5]

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[2] The words, "Conference" and "conference" will occur frequently throughout this report. The capitalized word, "Conference," will be used to refer to specific conferences which have been named or otherwise identified--such as the Conference in question. The word, "conference," in lower case letters, is the generic term. It will be used to refer to conferences in general.

[3] A summary of the Regional Planning Conference is given in Appendix A, "Regional Planning Conference."

[4] The members of this Committee, who were also responsible for developing the Regional Planning Conference, are identified in Appendix F, Section 3. Some time later, with additional members and replacements, the latter group became the Michigan State University Committee for the New Media Theory Conference (Appendix F, Section 8). As such, it was responsible for planning all phases of the Theory Conference project. In this task, it was assisted by the Regional Advisory Committee (Appendix F, Section 7)--particularly in identifying potential resource people and participants.

As paraphrased from the formal proposal, the purposes of the New Media Theory Conference were projected as follows: (1) to explore the problems and potentials of a theoretical base for planning and executing new media research, and for disseminating and applying the findings of this research; (2) to experiment with and to analyze/evaluate the effects of a conference designed to do well that which conferences do best;[6] and, (3) to develop the project report as a significant publication on the role of scientific theory in research and application generally, and in the new educational media specifically.

Conference Design and Execution

The Conference program was built around five areas of content: scientific theory in general, theory in education, communication theory, social theory, and the role of theory in new media research and application.[7] At the Conference, each area of content was developed cyclically. Each cycle consisted of three steps: (1) a formal content presentation to the group as a whole; (2) comments, questions, and general consideration by the total group of the formal presentation; and (3) division into small work groups for more specific analysis, discussion, and recording of major areas of group consensus. Informal housekeeping, orientation, and/or evaluation activities preceded or followed each of these cycles. Finally, at the end of the Conference, there was a general session at which each of the work-discussion groups reported on the results of its deliberations, and each participant commented on Conference experiences in a brief "graduation" speech.[8]

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[5] A detailed abstract of the formal project proposal is given in Appendix B, "Theory for the New Media."

[6] The formal report on this aspect of the New Media Theory Conference project is being prepared under the title, Anatomy of a Conference.

[7] The five content elements correspond to the five working papers presented in Part II of this report.

The execution of the Theory Conference was the general responsibility of the Michigan State University Committee for the New Media Theory Conference.[9] It was aided in this work by the Regional Advisory Committee--particularly in the matter of identifying resource people and participants.[10] In addition, consultants from the three Michigan State University divisions sponsoring the Conference--the Continuing Education Service, the College of Communication Arts, and the College of Education--assisted with various aspects of the undertaking.[11]

Conference Experimentation and Evaluation[12]

Along the experimental dimension, a variety of provisions were made to ensure that the Theory Conference would do well that which a conference does best. Primarily, this emphasis required that the Conference focus on: (1) communication and interaction in face-to-face situations, and (2) factors which facilitate this kind of interaction. Clearly, these requirements meant that the traditional "paper reading" occupation of conferences would have to be minimized.

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[8] The general development pattern is perhaps most clearly reflected in the Conference program--Appendix E, Item 3.

[9] The membership of this Committee is given in Appendix F, Section 8.

[10] The members of the Regional Advisory Committee are identified in Appendix F, Section 7.

[11] These people are identified in the various listings of Appendix F, Sections 2, 3, 5, and 8.

[12] Complete details on the experimental and evaluative aspects of the New Media Theory Conference are reported in Anatomy of a Conference currently in preparation.

The focus on face-to-face interaction is reflected in provisions such as: (1) careful briefing of participants on the unique features and commitments of the Conference,[13] (2) closely coordinating the development of the pre-Conference working papers,[14] (3) asking the participants to study the working papers before the Conference, (4) using participant feedback to guide the preparation of the Conference presentations,[15] and (5) allocating major amounts of Conference time to activities which, in general, tended to justify the essential characteristic of a conference--the bringing together of people for verbal exchanges.[16] In sum, the Conference attempted to minimize the presentation of new information, and to maximize the analysis/consideration of essentially common and previously communicated information.[17]

The attention to factors which would facilitate the essential features of a conference, face-to-face communication/interaction, is reflected in provisions such as: (1) careful briefing on group discussion procedures, processes, and products; (2) emphasis on facilities and services contributing to an efficient, permissive but purposeful Conference atmosphere; (3) continuous indexing and adjustment of Conference processes; and (4) informal social activities built on themes directly related to Conference objectives.[18]

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[13] The major document for briefing participants on the Conference is given in Appendix C.

[14] The nature of the working papers and suggestions on how they might be developed are given in Appendix D.

[15] The means used to obtain feedback are described in Appendix E, Items 1 and 2. The relationships between the working papers and the presentations are given in Appendix D, Section II.

[16] This aspect of the Conference is perhaps best illustrated by the Conference program given in Appendix E, Item 3.

[17] The underlying rationale is explained in detail in Appendix C, Section III, "Rationale and Development."

[18] These items are touched upon, in various contexts, in Appendixes B, C, D, and E.

Along the evaluative dimension, plans were made to collect both formal and informal data indexing Conference processes and effects. The more formal analytical-evaluative data collection devices included: (1) pre-Conference, post-Conference, and delayed post-Conference semantic differential instruments; and (2) pre-Conference and post-Conference questionnaires. Sources of less formal information on Conference dynamics and effects included: (1) pre-Conference and post-Conference correspondence, (2) reactions to the pre-Conference working papers, and (3) both oral and written comments and observations made during the course of the Conference.[19]

Summary: Pre-Conference Working Papers

Development of the Working Papers

The working papers represent the first step of an attempt to develop a conference which would emphasize the essential feature of conferences in general: a group of people assembled for face-to-face communication/interaction on subjects of mutual concern. The working papers were prepared by an outstanding group of resource people. These people worked from a preliminary set of specifications and met to coordinate their efforts when their papers were in first draft form.[20]

The five working papers were mailed to participants before the Conference--at approximately weekly intervals. Each participant was asked to react to each paper in terms of: (1) a set of three open-ended questions developed in consultation with the authors, and (2) a completely unstructured invitation to submit comments and reactions.[21] This feedback was used to guide the development of the Conference presentations and to provide evaluative data. The five papers themselves dealt with three levels of content: (1) the structure and function of scientific theories in general, (2) three examples of partially formulated theory--in education, communication, and sociology, and (3) the implications of theory for research and application in the new educational media.[22]

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[19] The analysis/evaluation of the Theory Conference is presented in full in Anatomy of a Conference now in preparation. Examples of some of the informal data collection devices are given in Appendix E, Items 1, 2, 8, and 9.

[20] The resource people are identified in Appendix F, Section 6. The informal specifications for the working papers and Conference presentations are given in full in Appendix D.

Structure and Function of Scientific Theories

The general purpose of Dr. Rudner's working paper is to focus attention on what Philosophy of Science has contributed to an understanding of the nature and function of scientific theories. The paper is developed in three parts: (1) the logic of fully formalized theories, (2) the logic of partially formalized theories, and (3) the functions of theoretical formulations in science. This content and structure are reflected in the outline which follows:

1. First, a general definition of theory is given, followed by a definition and explanation of the development of a theory as a fully articulated deductive system. This deductive system is called a fully formalized theory. Essential characteristics of such theories are examined, and examples are given. Extension into the social sciences leads to the conclusion that partial rather than full formalization is, at present, a more prudent expectation in this field.

2. The logical problems of theory construction are then examined in terms of two processes: (a) the process of theory formation and formalization, and (b) the process of introducing concepts into a theory. The discussion includes definitions and

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[21] These forms are described and illustrated in Appendix E, Items 1 and 2.

[22] This three-element program structure is described in detail in Appendix B, Sections I and II.

illustrations. It concentrates on the more operationally essential aspects of the subject.

3. The preceding consideration of key concepts and processes leads to the conclusion that, particularly in the social sciences, only partial formalization of theories is presently to be expected. The remaining discussion of the paper is addressed to two questions: (a) How far can we, or ought we, go in formalizing theory at any particular stage of inquiry? and, (b) What formalizing techniques are available?

4. Partial formalization of theories is then analyzed in terms of the nature and the consequences of the presupposition of knowledge (content, or subject matter) from areas non-indigenous to the theory in question. Presupposition eventuates in the use of terms and concepts which are undefined in the particular theory being considered. Presupposition usually entails quasi deduction, that is, the "double" failure to specify premises, and to specify the steps and the rules for deducing (deriving, or reaching) conclusions.

5. The paper then considers the problems of concept formation in partially formalized theories. The analysis concentrates on three ways of introducing concepts into a theory: (a) explicit definition, (b) specification of conditions of application, and (c) the method of relative primitives, that is, the introduction of terms in ways other than (a) and (b).

6. The paper does not resolve clearly the issue, "How far to formalize?" Suggestive assistance is given by two "rules": (a) formalize as much as you can, and (b) formalize to the extent that is fruitful. It is noted, however, that neither rule is operationally satisfactory because of the lack of criteria of application. In practice, the issue of formalization is usually resolved on the basis of intuition. . . .

7. Finally, scientific theories are examined in terms of their two major functions, explanation and prediction. Analysis of these two processes leads to the observation that their logical structure is identical. The resulting implication is: "If we can explain an event, we could have predicted it. . . ."

Learning-Behavior Theory and Education

Dr. Logan examines a variety of theoretical issues in the experimental psychology of learning in an attempt to find sentences which might help stimulate fruitful research in education. Perhaps the most important ones may be summarized as follows:

1. Organisms learn not only the qualitative (e.g., topographical) properties of responses, but also the quantitative (e.g., speed) properties. For example, practicing writing slowly leads to learning to write slowly. Educational programs should be designed to train in all of the important aspects of a response.

2. The same total reward can be given in a variety of ways which differ in their effectiveness. Particularly important are conditions in which increased reward is correlated with improved performance. For example, a student will learn to add faster if he is differentially rewarded for any increase in speed over his individual past performance. Extrinsic rewards can be adapted to such conditions more easily than grades.

3. Ultimate performance is better the closer the training conditions approximate the testing conditions. For example, a student may learn the multiplication tables accurately in the quiet solitude of a teaching machine, and then miss what is ostensibly the same problem when buying goods in a noisy store. Ideal training conditions probably vary depending on the stage of learning.

4. Virtually all applications of learning principles involve constraints which pose a maximization problem. For example, distributed practice is generally better than massed practice in terms of learning per trial. But since massed trials take less time, learning per hour may be greatest at an intermediate degree of spacing. Learning models can be useful in determining optimal programs.

5. The use of principles of behavior requires explicit statements of objectives. For example, the best program to produce retention of information may differ from the best program to enable creative utilization of the same information.

Communication Theory and the Use of the New Media

The working paper by Dr. Erwin P. Bettinghaus begins with a brief historical review of the development of communication as an academic discipline. It concentrates on three propositions which link communication and the new media: (1) the concern with the new media grows from roots common to both communication and education, (2) attempts to produce visual or verbal descriptions of the communication process have generally ignored the communication role of the new media, and (3) balance theory provides a fruitful approach to the research and application problems of the new media in education.

The foregoing propositions outline the setting of two lines of analysis followed in the paper: (1) the relationships between communication "theory" and the new media, and (2) the relationships between balance theory and the new media. In turn, these two lines of discussion branch into several topics specifically treated in this working paper. In numbered-item form, they are:

1. Definition, comparison, and illustration of the concepts "theory of communication" and "model of communication" as a basis for looking at levels of investigation. These levels of study are classified as descriptional, operational, and functional.

2. The presentation of communication theories and models is based on the observation that, at present, there exists no distinctive communication theory as such. The working paper then presents illustrated descriptions of seven models of the process of communication: (a) speaker-listener, (b) mechanical-informational, (c) speaker-audience, (d) source-message-channel-receiver, (e) psychological, (f) perception-oriented, and (g) sociological. This part of the paper concludes with a summary which points up the relationships of the discussion of the first two of the three basic propositions underlying the working paper.

3. The third of the paper's basic propositions, balance theory and the new media, is examined in terms of the nature and basic tenets of balance theory. The examination centers around an analysis and illustration of balance theories which exist under a variety of labels, for example: (a) Newcomb's "strain toward

symmetry"; (b) Osgood, Tannenbaum, and Suci's "principle of congruity"; and (c) Festinger's "theory of cognitive dissonance." A summary of the common elements of balance theories is then presented.

4. The paper concludes with a discussion of extensions and applications of balance theories to the new media in education. Specific suggestions are offered for research on the new media under four divisions: communication sources, communication channels, messages communicated, and communication receivers. Particular emphasis is placed on the fact that no specific communication theories exist, but that many theories of human behavior can be adapted for the purposes of planning, carrying out, and applying research on the new media in education.

Social Theory and the New Media

The working paper by Dr. Morris Janowitz proposes a twofold basis for analyzing the actual and the potential effects of the new media. The proposed approach requires that the new media be regarded both as technologies and as social-organizational systems, and in terms of the social environment in which they operate. Three models are available for this analysis: (1) the mass society model, (2) the behavioral science model, and (3) the functional analysis model. Each of these models provides a value orientation and a typology of analysis. The three models share some of the same assumptions. The third model is the one actually usedin the analysis presented in the working paper. . . .

1. For the analysis of the actual and potential effects, the new media are considered to have three functions: socialization, information, and mobilization. The working paper concentrates its analysis on ". . . the convergence of the new media and the mass educational system." It suggests that the impact of the new media might result in a two-track educational system: the custodial and the problem solving--with the latter to be preferred.

2. The paper then analyzes the effects and the social environment of the new media. It touches on some of the significant factors in these two areas, and suggests what the new media can contribute in developing a problem solving approach to mass education.

3. The next part of the working paper examines mass communication as a social process. This examination begins with an analysis of the inadequacies of television research based on stimulus-response theory. In contrast, it is noted that, at present, contributions of greater educational significance are being made by research based on television as a social process.

4. The fourth major part of the working paper argues that a valid understanding of emerging trends requires that the new media be regarded as a social process rather than a technology. The consequences (largely) of the technological approach are cited in the case of textbooks, instructional materials, curricula, and the processes of school administration. The fate of educational radio is analyzed as a background for a consideration of the limitations and the potentials of the new educational media.

5. The working paper concludes with a discussion of the professional implications of research on the new media. These implications are both drawn and implied from issues such as: basic *versus* applied research, the essential unity of theory and practice, research in a "total" environment, and cooperation among research and professional workers.

Research and Implementation in the New Educational Media

The working paper by Dr. Charles F. Hoban focuses on the implications of scientific theory for educational media research and for educational practice--as exemplified in the formulation and implementation of educational policies. Three categories of problems, faced in the working paper and in the Conference on Theory for the New Media, are identified:

1. The existence of gaps between formal requirements and the actual practices of theory formulation, between theories relevant to formulated research problems and the actual research on educational media, and between theory and research and the application of both.

2. The limitations on progress and development which flow from concepts of relevant theory, from concepts of research

methods, from concepts of educational media, and from concepts of problems in education.

3. The limitations on progress and development which are imposed by theorists, by researchers, and by practitioners who minimize professional risk by " . . . hewing closely to professional party lines and visibly conforming to them."

The remaining sections of the working paper are devoted to offering suggestions, explaining, and documenting some requirements for improvement. The "requirements" advanced may be brought together into three groups:

1. Changes in our ways of looking at, and thinking about, these kinds of problems;
2. Development of intermediate mechanisms which will bridge the gaps which exist; and
3. Development and acceptance of a more comprehensive concept of the functions of the educational media.

A clear and forceful summary of the author's point of view is given in the last section of the working paper entitled, "The Nub of the Matter."

Summary: Work Conference Presentations

Nature of the Conference Presentations

The Conference presentations were projected as extensions of the pre-Conference working papers. That is, the presentations were to be based upon the working papers only in a relative sense. The authors could choose (and were urged to do so) to analyze important aspects of the working papers, or illustrate critical concepts, or demonstrate applications, or . . . follow a direction suggested by the pre-Conference feedback from participants. In addition, it was suggested that each of the Conference presentations be made an occasion for demonstrating (unobtrusively) effective application of new media methods and devices.[23]

The content of Part III of the report illustrates both the potentials and (by omission) the hazards of the suggested approach. On the negative side, three of the Conference presentations have not been included in the report because they (largely) duplicated the pre-Conference working papers. On the other hand, the two presentations included in Part III illustrate highly creative responses to items of the original "prospectus," namely: (1) the first or "education theory" presentation illustrates and extends the corresponding working paper--in Part II of the report, and (2) the second paper on "theory application" develops an integration and extension of "all" of the working papers and presentations. In addition, both of these presentations make effective use of new media methods and devices.

A Micromolar Approach to Education and the New Media

Dr. Logan's pre-Conference working paper examines issues in learning theory as a means of identifying productive areas for research. His Conference presentation focuses on a narrow facet of one category of these issues, namely, response speed. The major points advanced, examined, and documented may be summarized as follows:

1. An important, yet somewhat peripheral value of a theory of learning, or a theory of human behavior in general, is that it forces objective descriptions of conditions and processes. It thus discourages conclusions based solely on intuitive and/or personal grounds.

2. An organism tends to learn best that response, in all of its dimensions, which tends to connect most closely with that (particular) stimulus in all of its details. That is, maximum learning tends to occur when an individual is required to do exactly the thing learned under exactly the same conditions as those under which he learned it.

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[23] The relationships between the working papers and the Conference presentations are "specified" in Appendix D, Section II.

3. Speed of response is a part of that which is learned. The development of more effective and more efficient learning experiences depends upon appropriate recognition of this principle. For example, a teaching machine based on this principle would be geared to more of the more significant dimensions of student ability--including the speed dimensions of learning input and response output.

4. The speed at which subject matter is presented tends to be directly related to the speed at which it is learned and (later) recalled or repeated.

5. Although fast responses tend to be more difficult than slow responses, the effect on response of a difference between input (presentation) and output (response) speeds is not thereby completely explained. A more general explanation appears to be that one condition for optimum learning is that input speed be the same as output speed.

6. A micromolar stimulus-response theory of learning assumes, in part, that fast responses are different from slow responses.

7. Classical theories of learning tend to define responses by their qualitative properties and by their topography. They treat speed of response as an indicator of how well something has been learned.

In total, Dr. Logan's presentation gives a clear-cut explanation and documentation of a micromolar theory of learning. In terms of Conference purposes, the most significant part of the presentation is its exposition of the research and professional practice application potentials of scientific theory. Specifically, some research potentials of theory are strikingly presented in the illustration of how a theory can be used to integrate research findings, and how it can be extended--not without some risk--to problems and to situations broader than those from which it was derived. Some professional practice potentials are identified and illustrated in the description of a way of devising a "best training schedule," and in examples (at the end of the presentation) of what a theory can contribute to the identification, explanation, and resolution of practical problems.

Toward the Reduction of a Difference-Signal

Dr. Bern's presentation to the Theory Conference builds on Dr. Hoban's pre-Conference working paper. It supplements and extends Dr. Hoban's manuscript, analyzes earlier papers and presentations, and develops an integrating point of view for future developments in this area.

It must be noted that Dr. Hoban was unable to attend the Theory Conference. Dr. Bern, with but a week to prepare, undertook the difficult task of preparing the concluding Conference presentation. The paper itself is a measure of his success. . . .

Dr. Bern's specific purpose is to reduce the "differences" between two interpretations of the structure, content, and processes of the New Media Theory Conference. These two interpretations are characterized by: (1) major emphasis on the new media as related to the nature of theory and to the potential role of theory in new media research and in the application of the findings of new media research, and (2) major emphasis on the process of integrating new media theory, research, and the application of research results. The major elements of Dr. Bern's presentation are emphasized by the numbered paragraphs which follow:

1. First, the "difference-signal" is explained and illustrated. Then, for purposes of "reduction," it is separated into two components: a new media and an integration component. The "reduction" is attempted by a series of questions and answers. First, plausible and leading questions are posed. Possible answers are sought by drawing upon the working papers, the Conference presentations, and upon related areas of research and analysis. This process is particularly interesting because of the nature of the data used, the patterns in which they are arranged, and the interpretations which are attached to them.

2. The new media component of the difference-signal is "reduced" by asking questions about the definition and meaning of the concepts "new media" and "theory." The answers which are suggested point to educational technology as the concept which promises to "reduce" this component of the difference-signal.

3. The integration component of the difference-signal is "reduced" by means of criteria used in evaluating theories. These

criteria are abstracted from the literature, from the pre-Conference working papers, and from the oral presentations made at the Conference. They are then offered as elements of a logical "instrument" for integrating new media theory, research, and the application of the findings of research.

4. The presentation concludes by questioning the basic assumption underlying the New Media Theory Conference, namely, that scientific theory--current or future--can make significant contributions both to planning and carrying out research on the new media in education, and to applying the findings of this research. In keeping with the spirit of the Conference, a positive reply is clearly implied. Purposefully, the reply avoids that degree of dogmatism which discourages additional questioning.

At least three elements of this presentation are noteworthy: (1) the concepts from systems engineering and research, (2) the references to related research and writing, and (3) the examples which are used--and the way in which they are combined for the purposes of the presentation.

Summary: Work-Discussion Group Reports

Setting for the Work-Group Reports

The decision to use work-discussion groups in the New Media Theory Conference was based on a two-dimensional rationale. First, there was the potential contribution of the group reports themselves. Second, and not entirely unrelated, was the realization that the discussion group approach provided an opportunity for exploiting more fully the unique, face-to-face, interaction potentials of the conference method.

The potential contribution of the work-group reports is indexed by the content of Part IV of this report and by the summary which follows. The attempts to strengthen the work groups as a unique aspect of the conference method are indexed by the provisions to enhance group interaction and productivity. Operationally, the latter was attempted by a combination of oral and (then) written communications emphasizing aspects such as: Conference purposes, work-group processes and procedures, possible topics for discussion, and the nature of the work-group reports.[24]

As suggested in the oral and written "specifications," the work group reports followed a variety of forms.[25] Some of the reports were directed to major audiences: the Conference planners, the United States Office of Education, and the profession generally. Others were organized in terms of four dimensions of the Theory Conference: (1) organization and content, (2) strengthening new media research and application, (3) improving the dissemination of research results, and (4) sharing the unique products of the work-group deliberations. Still other reports were directed entirely along the "unique products" dimension. The summary which follows uses the four dimensional structure.

Conference Organization and Content

In general, the groups which addressed themselves to this subject grouped their comments in three categories: positive, negative, and "other."

Theory Conference Strengths.--The major strengths of the New Media Theory Conference were identified approximately as follows:

1. The quality of the resource people, the working papers, and the Conference presentations tended to be high.
2. The idea of sending the working papers to participants and soliciting their reactions prior to the Conference was excellent.

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[24] The documents dealing with the formation, operation, and reports of the work groups are given in Appendix E.

[25] Appendix E, Item 9 gives the detailed suggestions for preparing the work-group reports.

3. The work-discussion group sessions were stimulating and productive.

4. The availability of the resource people as work-group participants and consultants was excellent.

5. The Conference was well paced and did not make unreasonable demands on the participants.

6. The excellent facilities and services contributed to the success of the Conference.

Theory Conference Weaknesses.--In general, what one group saw as a strength another group saw as a weakness. However, the major thrust of the critical comments was in the direction of how what was done might be improved--or what additional alternatives might have been considered. In sum, the Theory Conference might have been improved:

1. If its objectives had been less ambitious and more clearly defined.

2. If the participants had been selected on a different basis and grouped according to area of professional interest/activity.

3. If the working papers and the Conference presentations had been less repetitious--and the latter more responsive to the pre-Conference feedback.

4. If the Conference program had been designed to include a greater variety of activities, to reduce differences in points of view among the resource people, to enlarge the discussion role of participants, and to give more attention to theory application.

5. If the work groups had been organized to increase member security and to improve communication.

Additional Alternatives.--Several groups, without identifying (explicitly) either Conference strengths or weaknesses, suggested alternatives which might have been, or ought to have been, considered:

1. The content of the Conference working papers and presentations might have been more "global" or general, and more compatible with extension/application to the new educational media.

2. The three most critical problems of the new media are related to: (a) the nature and content of theory, (b) the problems of communication among academic disciplines, and (c) the task of learning about significant research findings.

3. A more productive conference approach might be to focus initially on typical problems in the new educational media and then to move to more basic, theoretical concerns.

Strengthening New Media Research and Application

In general, the observations and recommendations offered in the work-group reports were given in some detail. They were addressed, explicitly or implicitly, to the new media research/application professionals and to the United States Office of Education as sponsor of the new media research and application program.

To the New Media Professionals. --Although stated in a variety of forms, the group reports usually identified their observations as "needs" and distinguished between practitioners and researchers as the "needy." Thus, to summarize both the "what" and the "who":

1. There is a general need to define terms clearly, to classify the new media, to relate research and practice to educational objectives, to develop measurement/evaluation devices, to develop theory to undergird research and practice, to encourage support of non-traditional research, and to encourage professional participation in developing the potentials of the new media.

2. The new media practitioner needs to develop understanding of the problems and implications of research design, to master the content and methods for bridging the gap(s) between theory and practice, and to become familiar with the significant research literature of at least one of the social sciences.

3. The new media researcher needs to become more sophisticated in designing research, to master the art and science of research design, to develop better research tools, to develop conceptual schemes for new media research and application, to obtain training in one or more of the basic social science disciplines, and to be able to make multi-dimensional analyses of data collected in multi-dimensional, new media research settings.

To the United States Office of Education.--The major suggestions and recommendations addressed to the United States Office of Education were:

1. Encourage and support new media projects focusing on research design and methodology, on open-ended instructional situations, and on the efficiency of media in reaching specified educational goals.

2. Sponsor multi-discipline work sessions to develop basic research materials for new media research.

3. Encourage and support multi-disciplinary task groups working on significant and manageable problems in new media research and application.

4. Support a delayed follow up of the New Media Theory Conference to determine its long range effects.

Improving Dissemination of Research Results

Although some of the preceding suggestions clearly apply to the dissemination of research results, additional possibilities were also reported by the work groups.

To the United States Office of Education.--Three major requests were directed to this agency:

1. Encourage and support conferences and workshops on new media research and application.
2. Collect, synthesize, and disseminate the findings of new media and related research.
3. Encourage and support increased contact and interaction among new media practitioners, researchers, and those who function as mediators between research and practice.

To the New Media Professionals.--In turn, the new media professionals--the researchers, the practitioners, and those in-between--were urged:

1. To up-grade their knowledge of the new media and related fields, and
2. To help devise the tools and the methods to exploit more fully and to add to this knowledge.

Unique Products of the Group Discussions

In addition to the informal comments and appraisals, and the more formal recommendations, several of the groups reported on unique approaches and schemes for achieving some or all of the purposes of the New Media Theory Conference:

1. Group B proposed an approach which posed basic questions about education and about the nature and potentials of the new media, and then combined these two aspects in order to determine how the new media fitted into the educational process.
2. Group D's approach to finding a theoretical base for new media research and practice was to fill in the gaps along a continuum ranging from theory/research to application/practice.

3. Group E chose to devote most of its efforts to the development of a ten-step policy for new media research and application.

4. Group C gave major attention to developing a systems approach to the new media and teaching-learning in an attempt at developing general guidelines for effective teaching by the new educational media.

Part II

Working Papers for the New Media Theory Conference

Structure and Function of Scientific Theories 29

Learning-Behavior Theory and Education 59

Communication Theory and the Use of the New Media 89

Social Theory and the New Media 125

Implications of Theory for Research and Implementation in the New Educational Media 143

Structure and Function of Scientific Theories

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Purpose and Definition

Introduction

One of the main purposes of the discussion to follow is to bring to your attention a set of powerful and significant results achieved in Philosophy of Science in roughly the past twenty-five years by men such as Braithwaite, Carnap, Churchman, Goodman, Hempel, and Nagel. These results, in the main, furnish the basis for my remarks about theories in social science.

However, in trying to convey these results to you, I am immediately confronted with a very wicked dilemma. Some of you may be already familiar with them. This possibility doesn't worry me too much, for the results are important enough to bear repetition. What does disturb me, rather, is the manner in which these results should be presented.

I have, prima facie, two alternatives. I might present the remarks in such detail, in such elementary step-by-step fashion, that none of them--or the jargon used to describe them--would seem in the least mysterious to you. The chief difficulty with this alternative is that its very simplicity is likely to insult at least half of you. The second alternative is, of course, to try for succinctness by a free and uninterrupted use of the quite "icebergian" or, to change the metaphor, very compressed, concepts that make up the jargon of logical analysis. This alternative, however, is likely to leave the discussion opaque to about half of you. It is thus likely to be insulting to those people who would not be insulted by the first alternative.

In the light of this situation, perhaps my best strategy is a minimax: choosing one of the two wicked alternatives, and thus assuring myself that approximately half of you will remain uninsulted by the manner of presentation. Despite this possibility, I have actually chosen the more risky strategy of compromising between a wholly elementary exposition and a wholly sophisticated one. To give a middling-sophisticated exposition is obviously more risky--since, if it is unsuccessful, all of you will be insulted. On the other hand, the rewards of carrying it off successfully are too compelling! The fact is, I just don't want to insult half of you.

As a result of my choice, there will be instances in which I am aware of having sacrificed expository simplicity for succinctness. Perhaps these instances can be elaborated later, if you have questions about them. . . .

Purpose

In this essay, my primary concern is with the nature and function of theories. The essay itself has three main parts: first, a consideration of the logic of fully formalized theories; second, a consideration of the logic of partially formalized theories; and third, a consideration of the function of some types of theoretical formulations in science.

Definition of Theory

I presume that I do not have to labor the point that there are few terms in the scientific lexicon whose use, both by scientists and

and non-scientists, has remained for so long in so scandalously an anarchic a state as has the term "theory." Like the term "model," about which I shall also have something to say, the term "theory" is used in a wide variety of senses. Many of these usages are quite obviously inane. Use of the term in such locutions as, "It's all right in theory but it won't work in practice," or "That's merely a theory and not a fact," are, for example, not ones with which the present discussion will be concerned. The sense of "theory" which it is the first task of this essay to explicate is the sense in which the term is used in expressions such as quantum theory, or relativity theory, or Hullian learning theory --that is, the sense in which we refer to thermodynamics, or to classicial mechanics, or to genetics as theories.

In this sense, it is relatively easy to give an initial characterization of theories: A theory is a systematically related set of statements, including some lawlike generalizations, which is empirically testable. Now it would be well to be wary of whatever this deceptively simple formulation seems immediately to convey to you. It is one of those "icebergian" formulations which I mentioned earlier. Indeed, to unpack it logically and completely (to change the metaphor again) would be a task immensely beyond the scope of any one essay. In elaborating on this formulation here, I shall not succumb to the very real temptation to talk about obvious candidates for elaboration, which occur in it, such as "lawlike generalization" and "empirically testable." Instead, I shall confine the discussion almost exclusively to the apparently unsensational--but, to my mind--utterly crucial term "systematically related."

What is meant by saying of a set of statements that they are systematically related in the sense relevant to our present concerns? I think almost anyone who comes to the age of reason in western society has at least an intuitive inkling of the import of the term. For example, we are all familiar with the view that it is not the business of science to heap up unrelated, haphazard, disconnected bits of information. It is an ideal of science to give an organized account of the universe--to connect, to fit together--in relations of subsumption, the statements embodying the knowledge which has been acquired. Such organization is, in fact, a necessary condition for the accomplishment of two of science's chief functions: explanation and prediction. But the sort of systematic relatedness epitomized among the statements of scientific theories is deductive relatedness. Thus, the actual formulation of scientific theories will approximate, to varying extents, the explicit deductive development and interrelationship of the statements they encompass. The full development of a theory as a completely articulated deductive system is called "a formalization" of that theory.

In practice, to be sure, only a very few theories achieve full formalization. Indeed, for reasons which will emerge presently, it is not altogether clear that attempts at full formalization are always good strategy. This observation holds particularly for those sciences in which our knowledge is relatively tentative and restricted, and our uncertainty about the precise meaning and centrality of the most frequently used concepts is marked.

In contrast with conditions which may belie the wisdom of some attempts at full formalization of theories in the social sciences, conditions in some of the physical sciences have been more promising. In some areas in physics, for example, conditions have favored productive attempts at full formalization of complete and ramified theories.

In physics, theories peculiarly amenable to full formalization have been of two kinds. First, there have been readily available purely formal (i.e., non-interpreted) systems with respect to which these theories have been easily put into the relationship of empirical interpretations[1] (e.g., in the manner in which physical geometries are related to purely formal geometries). Second, there have been theories such that, on the one hand, there was little disagreement about the meaning and the centrality of the concepts they used; and, on the other hand, the theory in question was regarded as virtually complete (in the sense that it appeared to make many of the significant assertions about the subject to which it referred). Classical particle mechanics is a theory of the second kind. The recent important achievement of its formalization by McKinsey and Suppes is, of course, the best evidence for the ripeness of theories, in such stages of "completeness," for full formalization.[2]

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[1] The technical sense of "interpretation" which is intended here will be explained below.

Despite these notable exceptions, it is scarcely controversial that the overwhelming majority of extant scientific theories, especially theories in social science, are not at present susceptible to easy or fruitful full formalization. However, one of the principle points to be discussed below is whether some partial formalization of many of these theories may be both desirable and practically accomplishable. In order to make clear the major points of this discussion, it will be necessary to specify in some detail characteristics of the formalized system of calculus.

Deductive Systems

Purely Formal Systems

I shall begin with a relatively loose description of a formal system in order to convey quickly an intuitive notion of that which is being discussed. A formal system is best construed as a special kind of language system.

Suppose we are faced with the problem of finding a way to generate a "natural" language, say English. What things would we have to know about English in order to solve such a problem? Please note that I am using "generation" in a way such that the generation of the English language is said to be accomplished by writing down, or by exhibiting in some other manner, every permissible (i. e., grammatically correct) English sentence. Correspondingly, the language is said to be generateable when a method is produced by means of which it is demonstrated that the language can be generated.

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[2] There are, of course, well known difficulties to the full formalization of any empirical theory. These difficulties involve those branches of mathematics which themselves have (thus far) presented serious obstacles to full formalization. In the context of this essay, set-theoretical axiomizations (in the sense of Suppes) as well as meta-mathematical (syntactical and semantical) treatments are undifferentiated as formalizations.

The "generation" problem thus becomes, "What do we have to know about English in order to be able to write down (for example) every grammatically correct English sentence?" Assuming, for the moment, that this task is finite, a little reflection will show that we would have to know at least two things. First, we would have to know the elements of the English language, that is, every word in the total English vocabulary. Second, we would have to know the rules governing permissable permutations of these elements, that is, the total syntax of English. In short, we would have to have a list containing every English word, and a list containing every English rule of grammar. The English language could then be generated simply by making appropriate applications of the items on the list of elements (words) to the items on the list of rules (syntax).

Now it is clear that in speaking about English--or, for that matter, about any natural language--in the manner above, we have been taking extravagant liberties. In particular, we have made some extremely dubious assumptions. Among them have been the assumption that there is a class of terms which cogently can be said to comprise the vocabulary of English, and the assumption that there is a class of rules which cogently can be said to be the syntax of English. Actually, we have good evidence that both of these assumptions are false. A natural language is obviously in constant flux, both with respect to its vocabulary and with respect to its grammar. Only a completely arbitrary decision could fix, at any given instant, any set of rules or words as constituting the English language.

But I began by referring to a "natural" language in order to emphasize the point that these assumptions are not dubious when made for constructed or artificial languages in which the vocabulary and the syntax can be determinately specified. The point is that the generation of a constructed language can proceed in the manner described.

There is, moreover, another important fact that dealing first with a natural language serves to highlight. You will have noted that at no point in the discussion of the task of generating a language was it necessary to refer to the meanings of the terms which are the elements of languages. It is indeed the case that, if there is available a list of the elements of a language and a list of the rules (the rules may, of course, be couched in another language and yet specify all permissible permutations of those elements), then the language can be generated without knowledge of the meaning of any of the terms of the language.

A purely formal system or calculus may be construed as a generated (or generateable, in the sense given above) language to whose elements meanings are not assigned, or the meanings of whose expressions, if they antecedently have meanings, are deliberately disregarded.

All calculi, then, have the characteristics given below. They comprise:

1. A class of primitive elements; and,
2. A class of syntactical rules for concatenating the primitive elements into more complex expressions, and for transforming complex expressions into other expressions.

In addition to these characteristics, most calculi contain:

3. A class of expressions, concatenated out of the primitive elements in accordance with 2, above, (but not derived by transformations on other expressions) which are the primitive concatenated expressions or axioms of the system;
4. A set of definitions through which new elements are introduced into the system by being defined in terms of the primitive elements.
5. A set of expressions, derived by transformations on the axioms, which are the theorems of the system.

It should be noted that not every element or term employed in a system can be defined in that system. It follows that the class of the system's elements will usually be divided into two kinds:

the primitive or undefined elements and the defined elements. The reason why some of the elements of any system must be left undefined is that to do otherwise would be to incur a vicious circularity--since any term in a system can be defined in the system only by terms of that system. Thus, if all elements of a system were defined, they would be defined in terms of each other.

In general, every expression of a system in which a defined term occurs can be replaced by an equivalent expression which uses only primitive elements of the system. In this sense and speaking strictly, defined terms are superfluous in a purely formal system. The raison d'etre for definition in a purely formal system is simply to take advantage of whatever notational convenience the definitions effect.

Usually, the syntax of a system is subdivided into two parts. First, there are the formation rules which specify what combinations of the primitive elements are permissible combinations. Second, there are the transformation rules which prescribe what permissible transformations can be wrought on permissible expressions in order to obtain other permissible expressions.

Again, it should be noted that a calculus usually contains some underived or unproved expressions, that is, some axioms. For much the same reason, namely, the avoidance of vicious circularity, it must contain primitive elements. In this case, however, it is vicious circularity in proof that is avoided rather than vicious circularity in definition.

The theorems of a system are derived by application of the transformation rules to the axioms of the system.

It should be again emphasized that the entire process of generating such a purely formal system is accomplishable purely syntactically, that is, without recourse to considerations of the meanings or of the semantical characteristics of any expression.

Interpretation of Formal Systems

A purely formal system, or calculus, then, is one in which meanings (if any) that the elements may have had associated with them are disregarded. Understanding the import of this characteristic puts us in a position to explicate more adequately the concept, deductive system.

Suppose that one of the axioms of our purely formal system is:

$$1.\quad aO(bOc) = (aOb)Oc$$

The symbols comprising this formula are uninterpreted in our purely formal system, that is, we assign no meaning to them. Now, suppose that, in formulating a series of rules of interpretation, we specify that the lower case alphabetical letters in the formula are to be construed as propositional variables (that is, as variables which take declarative sentences as substitution instances); that "O" is to be construed as indicating the operation of disjunction; that "=" is to be construed as indicating the biconditional operation; and, finally, that parentheses are to be used to indicate the scope of operators. If we do this, we find that our interpretation yields a truth of Sentential Logic, namely, the one ordinarily written:

$$1'.\quad pV(qVr) \equiv (pVq)Vr$$

Now, if all the axioms of our system--let us call the system "B"--are similarly interpretable as truths of the Sentential Logic, the latter is said to be an interpretation of B, and B may be said to have a model in the Sentential Logic. In the present case, our example axiom is one from the purely formal system generally referred to as Abstract Boolean Algebra--as that system is frequently formulated. If the axioms of Boolean Algebra are, all of them, interpretable as truths of the Sentential Logic, we say also that the axiom set of Boolean Algebra is satisfied in the Sentential Logic. The Sentential Logic does, as a matter of fact, satisfy the axioms of Abstract Boolean Algebra.

It is of some interest to note that the Sentential Logic is not the only model of Abstract Boolean Algebra. The axioms of the latter are also, for example, satisfied in the Logic of Classes. One may give some indication of the power which dealing with formal systems confers, and also of the importance of the concept "model" in formal science, by pointing out that every theorem of a formal system will be satisfied in every system which satisfies its axioms. That is, every theorem of a formal system will be satisfied in every system which is a model of it. This being the case, it is possible, in constructing proofs in a purely formal system, like Boolean Algebra, to prove not only the single theorem of that system but rather the numerously populated classes of theorems in all of its models simultaneously.

Semantical Rules of Interpretation

As has been mentioned, the generation of a purely formal language system takes place without any recourse or reference to the meanings of the expressions of the system. However, in order for such a system to have an application, it is necessary to interpret it. That is, it is necessary to specify explicitly meanings for the expressions of the system. Following Carnap, this specification may be accomplished by supplementing the set of syntactical rules used in generating the system by a set of semantical rules which specify an interpretation of the hitherto purely abstract system.

The set of semantical rules is divided into two subsets. One subset comprises the rules of designation for the primitive elements of the system--the primitive elements other than logical signs. These primitive elements then become the descriptive or empirically referential terms of the interpreted system. Their designata are construed as having been determined by explicit semantical rules of designation. The second subset determines a class of truth conditions for expressions of the system and thereby also furnishes interpretations for the logical (i.e., non-designative) signs of the system.

The descriptive terms of the system, whose designata are determined by the rules of designation, may be divided into names (which designate individuals) and predicates (which designate properties). A given rule of designation will specify, for each name or predicate, some thing or property as its designatum.

A semantical rule of truth might be couched as follows:
RULE: Any expression of the form "____ is ____," (where the

first blank represents the occurrence of a name and the second blank the occurrence of a predicate) is true, if and only if, the thing designated by the name in the first blank has the property designated by the predicate in the second blank.

It should be noted that this rule, in laying down a truth condition for the expression, gives us an interpretation of the logical operator "is," namely, the predication of properties of individuals.

A purely formal system, then, will be said to have been interpreted if a complete set of semantical rules of interpretation--of the sort just described--has been provided for all of the elements of that system.

In this essay, when reference is made to a fully formalized empirical theory (that is, a theory which contains among its axioms some empirically true or false statements), what is intended is that rara avis, an empirical theory which has been explicitly and completely structured as an interpreted deductive system.

Concept Formation and Introduction

Explicit Definition

It has frequently been pointed out that two crucial foci of logical problems of theory construction are: (1) formalization and formation, and (2) introduction of concepts into a theory. In the preceding section we have surveyed conditions involved in the full formalization of a theory. In this section, we shall turn to factors involved in the introduction of concepts into a theory.

In a fully formalized theory, the procedure for introducing new concepts or new terms is well specified. The method must be equivalent to the introduction of the term by explicit definition--the definiens being composed either of primitives or terms ultimately defined by primitives. In an interpreted deductive system, a definition may perhaps best be understood as a rule or a proposal concerning linguistic replaceability. It ordinarily has the following form: ----- = df ..... and may be read "______ (some term) is definitionally equivalent to ..... (some other term)." The term being defined is called the *definiendum* and occurs to the left of the definitional equivalence sign. The term by which the *definiendum* is defined is called the *definiens*. The specification, in an explicit definition, that some term is definitionally equivalent to some other term is, at least, a specification that the *definiendum* and the *definiens* are mutually replaceable in any statement in the system without altering the truth value of that statement. Thus, *a definition is a stipulation that, if a statement is true, it will remain true after the replacement of any of its terms by definitionally equivalent terms--and correspondingly for a false statement*. This *salva veritate* condition, as has been indicated, is a necessary part of what is specified in every explicit definition. Indeed, it has been held that this condition is the whole of the import of any assertion that a pair of terms are definitionally equivalent.[3]

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[3] It is the existence and *prima facie* cogency of the *salva veritate* condition which throws doubt on the propriety with which so called "operational definitions" and "ostensive definitions" are thought of as definitions. It seems evident that the processes named by these two terms are thought to be definitions because they are processes by which the meaning of terms are conveyed. But little reflection is needed to reveal that conveyance of meaning is not a necessary, and certainly not a sufficient, condition to be fulfilled by a definition.

It is not a *sufficient* condition, for meanings are conveyed by an immensely large number of things (from the tilt of an eyebrow to the tilt of a B-59 wing) which it would be absurd to refer to as "definitions."

That it is not *necessary* for a definition to convey meaning is evinced by the existence of the great number of definitions in purely formal mathematics and logic which do not convey meanings and which are introduced solely to serve the purpose of notational convenience.

In the light of this discussion, "operational definition" and "ostensive definition" are recognizable as misnomers. They

Ideally, then, an empirical scientific theory will comprise an explicitly articulated deductive system into which new concepts are to be introduced by means of explicit definition in terms (ultimately) of the primitives of the system. A somewhat simplified example will illustrate the process.

Suppose that we are interested in introducing the "new" concept "Sister" into an axiomatized theory of kinship in Anthropology. Assume that the universe of discourse, that is, the class of all objects covered by the theory, is the class of human beings. Assume also that the usual logical operations have been appropriately introduced, and that among the extralogical (descriptive) primitives of the system are "Male" and "Parent."[4] "Sister" may be introduced into the system through the chain of definitions given below. Notice that this chain of definitions also introduces, incidentally, the "new" concepts "Child," "Sibling," and "Female."

Definition 1. "x Child y" ≡ df "y Parent x"

Definition 2. "w Sibling z" ≡ df "(Ex) (Ey) [(w Child x) · (w Child y) · (z Child x) · (z Child y) · ∼(x ≡ y) · ∼ (w ≡ z)]"

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refer, respectively, to: (1) the processes of conveying the meaning of a term by indicating the operations required to test for the presence of the thing to which that term refers, and (2) the processes of conveying the meaning of a term by exhibiting the things to which the term refers. It would be somewhat more accurate to label these processes "operational conveyance of meaning" and "conveyance of meaning by ostention."

Of course, although definitions need not convey the meanings of their *definienda*, it is obvious that they sometimes do and that they are frequently constructed for the purpose of doing so.

[4] In what follows, an expression like "Male x" is to be read "x is a Male." Expressions like "x Parent y" are to be read "x is a Parent of y." The sign "·" is read "and." An expression of the form "(Ez) [. . . . .]" is read "there is at least one thing z, such that . . . . ." The sign "∼" is read "it is not the case that"; and the sign "≡" is read "is identical with."

Definition 3. "Female x" $\equiv$ df "$\sim$Male x"

Definition 4. "x Sister y" $\equiv$ df "x Sibling y $\cdot$ Female x"

Little reflection is required to see that many other kinship terms could be easily introduced, solely on the basis of the two extralogical primitives and a set of logical concepts.[5]

Thus far we have not turned our attention to any of the conditions which might determine the selection of a set of extralogical (descriptive) primitives in a formalized theory. One of these conditions is of special importance for the present discussion. Specifically, this condition is that sets of such primitives should be comprised of observational, or as we shall say more frequently, "experimental" terms. The import of positivist, pragmatist, and operationalist philosophies of science on the thinking of methodologically self-conscious scientists has perhaps been so pervasive as to require no extended comment on this point here. It is clear that one way in which the demand of experimental testability on any candidate concept for a theory can be met, is to introduce it into the theory through explicit definition by primitives which, themselves, are known to have experimentally testable reference. Thus, the importance of the experimental testability condition for a set of primitives lies in the fact that any set which meets this condition in a theory guarantees that all new concepts introduced through explicit definition will, as a consequence, be experimentally testable concepts.

Dispositional Predicates

All of the considerations, which have thus far been elucidated, have application only to fully formalized empirical theories. However, as indicated at the outset, in the present stage of our scientific knowledge, few theories indeed lend themselves to easy or fruitful full formalization. Accordingly, it is appropriate to consider what techniques may be available for concept formation and introduction in theories which are not fully formalized. Before going into this matter, it will be convenient to consider certain difficulties which confront important cases of concept introduction--in fully formalized as well as in partially formalized theories.

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[5] A similar explanation and a clear discussion of explicit definition may be found in the Hempel citation given in the bibliography at the end of this essay.

One such difficulty is presented by the apparent necessity to introduce into any empirical theory of significant predictive power, a class of concepts or terms that are usually referred to in the literature of analytic philosophy as dispositional predicates. "Dispositional predicates" is a class of terms which refer to dispositional properties.

It is clear that, when we assert that some entity has a disposition to manifest, or a potentiality for manifesting, some property, we are saying something different from the assertion that it has manifested or does manifest that property. Thus, to say that a house is combustible is obviously not the same thing as to say that it is burning--as insurance companies will cheerfully affirm. Indeed, it is obviously possible that entities, of which we assert truly that they have dispositions to manifest certain properties, may never exhibit those properties.

The ubiquitousness and the pivotal character of dispositional predicates in all branches of empirical science is apparent when we remember the frequency of occurrence if "ible" and "able" in terms like "combustible," "soluble," "observable," "filterable," etc. Terms of this kind, so to speak, wear their dispositionality on their sleeves. In addition, the nature of dispositional predicates is further illustrated when we consider the very large number of terms like "magnetic," "elastic," "attitude," "reflex," "habit," "response repetoire," "personality," "hardness," "conductor," etc. Under analysis, these terms turn out to be dispositional predicates. A glance at even this minuscule list is sufficient to indicate the essential role of dispositional predicates in the theories of contemporary science.

The difficulties presented by these terms stem from the fact that, despite their crucialness in science, we cannot in general adequately define such terms by non-dispositional, that is, "direct observation" terms of the sort we stipulated to occur in the set primitives of a formalized empirical theory. The significance of this negative result in contemporary Philosophy of Science is that it places in doubt any general program for theory systematization. Like the kind of full formalization suggested above, it limits the method of concept formation or introduction to that of explicit definition on the primitive basis of "direct observation" terms.

It is clear that, in general, a method other than explicit definition is required for the introduction of dispositional predicates. Such alternative methods, of varying efficaciousness, have been suggested. For example, Carnap's technique of reduction sentences is, perhaps, the most widely known. However, insofar as a device alternative to explicit definition is used, the resulting systematization of the theory will fall short of full formalization on a directly observable primitive basis. Since the problems of introducing dispositional predicates remain, the use of devices like reduction to accomplish their introduction--or even better alternative devices--may be expected to be a characteristic of partially formalized theories.

Perhaps what I have said up to this point is sufficient to give you: (1) a notion of the logical structure and character of empirical theories, and (2) a notion of a model. However, we are not yet quite ready to turn our attention specifically to theories in the social sciences. . . .

Earlier in my essay, I remarked on the fact that very few scientific theories have been, at least up to the present time, formulated as fully formalized deductive systems. The reasons for this condition are varied and many and, I think, utterly fascinating.[6] However, it would be too much of a digression to examine them here. Suffice to say that, in most scientific areas, certainly in the social sciences, we must at present rest content, in our theories, with something short of full formalization.

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[6] A dispositonal predicate is not the only kind of term which presents obstacles to definition by the experimental primitives of a fully formalized theory. It has been established that metrical concepts ("length," for example), whose range of values may include portions of the sequence of reals, cannot be defined by means of "direct" observation or experimental terms.

This observation, of course, leads to some provocative, and--it seems to me--quite important questions. For example, "How far can, or ought, we to go at a given stage of inquiry in formalizing theory?" Equally important, "What are the partial formalizing techniques that might be fruitfully applied?"

Now, difficult as it may be for you to believe, philosophers of science as a tribe sometimes manifest certain defects. These defects occasionally take the form of a kind of insensitivity to some of the most poignant methodological troubles which bedevil the scientific colleagues whom they sometimes purport to serve. The news that classical particle mechanics has been fully formalized, and an accompanying lecture on what this means, may bring precious little comfort. It may be illuminating to the social scientist who sees himself as trying to pierce just a little bit the veil over the connections, if any, among the three or four diminutive hypotheses he has been nursing. A partial formalization, however, might be immensely helpful to him. Unfortunately, the problems of partial formalization have received almost no attention from philosophers of science. I think that these problems are particularly relevant in the social sciences. In the brief sections which follow, I shall try to introduce notions which I believe have special relevance to these problems.

Partial Formalization

Theories in the Social Sciences

The foregoing considerations have led inevitably to the conclusion that, in the systematization of empirical theories (certainly in the social sciences), we shall have to be content with less than full formalization. This conclusion, of course, leads to the provocative questions: "At any given stage of inquiry, how far can we, or ought we, to go in formalizing theory?" and "What are the formalizing techniques, even partial ones, which may be fruitfully applied?" These questions, and certain related considerations, will occupy us through the remainder of this essay.

Systematic Presupposition

One of the frequently met concomitants of merely partial formalization is the presupposition of large segments of subject matter of a field or discipline other than that to which the theory being constructed is indigenous.

Even a cursory glance at general textbooks in fields like Physics, Chemistry, Biology, Psychology, Sociology, and Anthropology will reveal that exposition in any of them employs non-indigenous concepts without explication, presupposing the antecedent clarity of such concepts. In a Physics text, for example, one is unlikely to find explications of the concepts of logic which (essentially) are being employed. In Chemistry, non-indigenous terms like "electron," "electrical current," and "temperature" occur, and are generally unexplicated. Similarly, there is no explication of such non-indigenous terms as "mass" and "elastic" in Biology; "biological organisms" in Psychology; "biological evolution" in Sociology and Anthropology; and a host of psychological, biological, and sociological terms in History and Economics. These terms, and scores of others, not indigenous to the theory which is presupposing them to be understood, are not ordinarily employed as primitives. They are employed in a fashion which is to be distinguished from that which characterizes unexplicated terms indigenous to the theory. The latter are employed as the theory's primitives, explicitly or implicitly.

Some of the discussion to follow will be illuminated if we pursue this distinction further. What I have been saying is that a partially formalized theory may comprise two kinds of terms or concepts which are unexplicated or undefined in that theory: (1) concepts indigenous to the theory which, at any given time, have the status of relative primitives; and (2) concepts not indigenous to the theory but which have a logical status still to be determined. We are here speaking of indigenous concepts in the sense, for example, that "mass" would be recognized as a "term of physics"; while "neurosis" would be recognized as a "term of psychology." More precisely, we shall say that a term t, which occurs in a theory s, is indigenous to s if:

(a) t is a primitive of s, or is introduced in s by means of the primitives of s, and,

(b) there is no other theory *s'* such that the condition described in (a) is met for *t* in *s'*.

A term in a theory is a non-indigenous one if it is not the case that it is indigenous in that theory.

Our present concern is with partially formalized theories. The importance of focusing attention on non-indigenous terms in such theories is that their occurrence will indicate that some portion (large or small) of the results of some other discipline is being presupposed in the theory. Thus, for example, the occurrence of the term "temperature" in some present-day physiological theory would indicate that a portion of thermodynamics was being systematically presupposed. The significant fact about such an occurrence is that, in asserting that a portion of thermodynamics has been presupposed, we are asserting that a number of statements from thermodynamics are being assumed as true in the physiological theory--or, at any rate, assumed as true in the sense that an explicit deduction of testable hypotheses comprised in the physiological theory would involve the explicit use of some thermodynamical statements from thermodynamics as premises.

In practice, of course, explicit deductions of the kind referred to immediately above are rarely formulated. In fact, failure to make such deductions, and thus to establish the warrant with which a putative prediction purports to be relevant to the testing of a theory, is one of the most frequently encountered ways in which current theories fall short[7] of full formalization. This failure to spell out the presupposed statements which would be necessary for the deductions constitutive of the theory's predictions and explanations is sometimes due, no doubt, to the theoretician's awareness of the technical difficulties which might be involved in spelling them out. But such failure is also frequently due to the theoretician's ignorance of just what, in this sense, his theory actually presupposes. Just to the extent that such ignorance obtains, of course, the theory's presuppositions are unexamined and unevaluated. To the extent that the presuppositions are unevaluated, our confidence in the theory's adequacy must be qualified.

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[7] The uses of terms like "fall short" and "failure," in the present context, are not intended to suggest value judgments. We are not considering here whether it is a good thing or a bad thing for theoreticians to formulate these deductions explicitly. We are only remarking on the fact that they do not usually do so.

Clearly, when there is knowledge that the material being systematically presupposed in a theory derives from a relatively well-confirmed body of statements and a relatively well-explicated region of inquiry (such as, say, thermodynamics), our anxiety about the adequacy of our presuppositions is not going to be the most pressing of our concerns. Usually, however, we are not as fortunate with respect to the material which our theory (and its apparently feasible experimental tests) requires us to presuppose. In such cases, the issue of weighing the cost (in its broadest sense) of making presuppositions explicit, and assessing this cost against the possible loss incurred through not doing so, becomes a poignant concern for the methodologically self-conscious scientist.

All of that which has been said thus far about the systematic presupposition of portions of "outside" disciplines in partial formalization applies with equal, if not greater, force where the material presupposed cannot cogently be construed as being at all indigenous to some other scientific area, that is, when it is made up of pre-scientific "common sense" or "common knowledge." Here, it is doubtful that even formulation of common sense presuppositions, when they are involved in a theory, will enable us to make adequate evaluations of the theory's adequacy since the concepts involved are likely to be vague or ambiguous--insofar as they are pre-scientific. Yet any reflective reading of social science theorizing will reveal the considerable frequency with which presupposition of common sense lore of this kind occurs.

Quasi Deduction

I shall characterize as quasi deduction any inference which purports to be a deductive elaboration of a theory (e.g., predictions, explanations, "hypothetical" consequences, etc.) but which, in fact, fails to meet the requisite conditions for a deduction--generally through failure to make explicit all of the statements requisite as premises, as well as all of the steps and rules requisite for deductively deriving the conclusion. In this sense of "*quasi deduction*," it is clear that the phenomena of systematic presupposition described in the preceding section, will usually entail *quasi deduction*. But there is one additional factor to notice here. In a theory, *quasi deduction* is not confined solely to the implicit assumption of non-indigenous material as premises. It is frequently the case that the statements suppressed in quasi deductive inferences would be, themselves, indigenous to the theory.

Again, insofar as *quasi deduction* characterizes a theory, the theory will fall short of full formalization. The considerations which apply in evaluating the adequacy of a theory, thus characterized with respect to non-indigenous material, will also apply with respect to failure to make explicit the assumption of indigenous statements. That is, the reflective theorizer's actual decisions in this connection will again be based on weighing the cost involved in making such assumptions explicit against the loss which may result from not doing so.

Relative Primitives and Concept Formation

In the two sections immediately preceding, I have considered partial formalization as a concomitant of failure to make explicit the deductions (that is, the relations of subsumption) in the use of a theory. In this section, attention will be focused not on problems of suppressed statements, but on problems of concept formation in theories which are not fully formalized. We shall be interested in the rationale or the justification of the concepts which occur in a partially formalized theory.

In such theories, we may distinguish three techniques or modes of concept presentation or introduction:

(a) Concepts may be introduced by explicit definition, or by some equivalent of explicit definition, such as recursion.

(b) Concepts may be introduced through the specification of a sufficient condition for their application.

(c) Concepts may be presented as relative primitives.[8]

Explicit Definition. -- I have already mentioned the techniques of explicit definition in connection with its occurrence in Calculi. Use of this technique in partially formalized theories will ordinarily differ from its use in fully formalized theories only insofar as no set of terms will be exhibited or construed as the primitives of the partially formalized theory. Hence no set of terms will be designated as the one in favor of which all defined terms may be eliminated.

Conditions of Application. -- Statements of a theory which specify a sufficient condition for the occurrence of the designatum of a concept, thereby also yield a sufficient condition for the application of that concept. Thus the statement, "If an animal suckles its young, then it is a mammal," not only specifies a sufficient condition for what is frequently called the occurrence of the property of being a mammal, but it also gives us a criterion sufficient (if the statement is true) for correct applications of the term "mammal."

You will have noted that specification of a sufficient condition for a term's application does not, of course, determine the usage of that term, nor give its "full meaning." In particular, the same theory may comprise a number of different statements yielding a number of different sufficient conditions (none of which need be necessary) for a given term's application. Thus a theory may comprise the statement, "If an organism has a backbone, then it is an animal," and also the statement, "If an organism is warm blooded, then it is an animal." Each of these statements partially determine the usage or meaning of the term, "animal." In a sense, both together more fully determine the usage of the term "animal" than either alone. However, neither separately nor together do they completely determine the usage or meaning of the term.

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[8] For present purposes, we shall construe all instances of concept occurrence in a theory which are not classifiable under (a) or (b) as instances of (c). This will include, among others, all of those instances in which a necessary but not a sufficient condition for the application of a concept is specified; as well as all of those instances in which a condition correlated with (but neither necessary nor sufficient for the occurrence of) the concept's designatum is specified.

Relative Primitives.--Finally, in partially formalized theories, there will usually occur terms which are not introduced in any of the ways discussed in this section. To these terms, we shall give the label, relative primitives. In so doing, we do not intend to suggest that the theoretician is utterly in the dark about the meanings of terms of this kind. He will have some clue to usage when, for example, a merely necessary condition for a term's usage is specified. That is, in this case, he will have at least one criterion for distinguishing objects to which the term does not apply. Similarly, even when only a correlated condition is specified, he will have some notion of the probability of a term's applicability to a given object. Indeed, should neither a necessary nor an explicitly correlated condition be specified for a given relative primitive, he would still not be forced to construe it as a "meaningless" term--for the term may well have some meaning wholly antecedent to its occurrence in the theory.

However, an important point is that, in a theory which has not been fully formalized, the status of terms not introduced by techniques such as those mentioned in (a) and (b) is only tentatively primitive. Such theories are subject to constant modification. With the acquisition of new knowledge, parts of such theories can come to occupy only a minor place in a "corrected" version of the theory--whereas, at an earlier time, they may have comprised the bulk of the information about, and occupied a pivotal place in, the theory's "subject matter." Accordingly, terms which function as primitives at one time can, at another time, be supplanted in this role by different terms. In a reformalized version of the theory, they may assume a non-primitive status. It follows that the "primitives" of a partially formalized theory must be construed as only relatively or tentatively primitive.

Formalization and Application

How Far to Formalize

In the foregoing discussion, I have pointed out that full formalization may not always be an accessible method for the formulation of a theory. In contemporary social science, full formalization is seldom possible. All of the considerations bearing on full and partial formalization which have been adduced thus far "lift and drop a question" on our plates: "Given a theory, the full formalization of which is not to be attempted, to what extent shall we formalize it?" There is possible a vast range of partial formalizations. A theory may be considered to have been partially formalized when even one putatively deductive connection has been exhibited among its statements, or when the usage of even one of its concepts has been partially determined in some explicit fashion. Between this extreme of a negligible degree of formalization and the opposite extreme of an almost complete elaboration of a theory as a deductive system, the theoretician will have tremendous leeway in the extent to which he may decide to formalize. What are the rational bases for his decision? Unfortunately, having "lifted and dropped" this question, I must say at once that I know of no wholly satisfactory answer. . . .

Simple and straightforward answers like, "The scientist should formalize as much as he possibly can," seem to be wrong. They are misleading. Pat answers like, "The scientist should formalize to the extent that is fruitful," also seem to be false. Such answers are trivial. By themselves, they yield no basis whatever for making decisions.

"Formalize as much as you can" might be sound advice if, for example, a scientist's only goal were the achievement of the most precise possible formulation of his theories. However, he is equally if not more concerned with a plurality of other goals. Among these goals are prediction, control, and the experimental testing of his theories. Attempts to achieve great precision in the formulation of a theory may conflict with the achievement of some of these other goals. At any given stage of a theory's development, insistence on great precision may be stultifying. Similarly, achievement of great precision may be undesirable, inasmuch as premature achievement of precision may tend to constrict inquiry. Finally, a disproportionate allocation of the scientific energies available to this one facet of the scientific enterprise might result in the neglect of other equally important aspects of the total enterprise.

In this light, we would not dispute the second dictum, "Formalize to the extent that is fruitful." However, to assume that this dictum answers the question, "To what extent shall we formalize?" is obviously to beg the question. Patently, our problem is to determine just what constitutes a fruitful degree of formalization at any stage of a theory's development. Doubtlessly, there is no further need to labor the point. . . .

It is clear that the non-existence of an adequate criterion for deciding on the extent of formalization has not heretofore had the effect of grinding to a halt theoretical activity in the empirical sciences. In the absence of an explicit criterion, theorists have made the requisite decisions willy nilly, consciously or unconsciously, haphazardly or after much reflection. Somehow, of course, the various disciplines have "got on." What I wish to emphasize, nevertheless, is that these decisions are perforce made in essentially an intuitive manner. Consequently, we are confronted with an aspect of the science of not inconsiderable importance which itself is scientifically out of control.

Uses of Theories

Up to this point, we have been concerned with what may be thought of as the structure of scientific theories. We shall now turn to a brief consideration of the two most important functions of theories: (1) explanation, and (2) prediction.

To begin with, let us consider what constitutes a scientific explanation. An explanation is vouchsafed in answer to the question, "Why?" However, in ordinary discourse, there are two distinct senses in which we ask a question. In the first place, we sometimes ask "Why?" in the sense, "For what motive?" Thus, when we ask a friend "Why?" he beat his grandmother, we are usually asking what motivated him to do so. Secondly, we also ask "Why?" in a quite different sense, namely, "How did it come about that. . . ?" In doing so, we do not necessarily make any imputation of motivation. What we are asking is, "How come?" in the sense, "In accordance with what natural regularities did this phenomenon occur?" Thus, in this day and age, when we ask, "Why do clouds cause rain?" few, if any, of us are asking, "What motives did the clouds have for causing rain?" No doubt, in the days when man was more prone to commit the fallacy of anthropomorphosis than he is now, the sense of "Why?" was more likely the motivational one. However, with the advent of the Renaissance and the age of science, we have presumably become more sophisticated. At present, the question "Why?" is usually construed in the sense of a demand for a scientific explanation. It is the second or the "How come?" interpretation of "Why?" which is being made.

When a young child asks, "Why did that toy balloon burst?" it may be asking for the balloon's motives. When we seriously ask the same question, we are asking for a scientific explanation. Suppose that someone should answer, "It burst because it was held near a flame, and thus became very hot." If we were reflective, this answer might not satisfy us. We might go on to ask, "What does the balloon's getting hot have to do with its bursting?" Our learned informant might now point out that, when gasses, such as air, are heated, they expand. In the case of the balloon, the increased pressure of the expanding air against the sides of the balloon caused it to burst. With this additional information, our informant would indeed have given us an answer which, regardless of its crudeness, nevertheless contains all of the elements of a full-fledged scientific explanation. His answer now would have incorporated some lawlike statements.

The structure of a scientific explanation of some phenomenon consists of three parts. There is first, a statement, let us call it E, which describes the event to be explained. Second, there is a set of statements, C_1 to C_n, which describe specific relevant circumstances antecedent to E, or correlated with it. Third, there is a let of lawlike statements, L_1 to L_n, whose imp port is roughly: "Whenever events of type C_1 through C_n take place, an event of type E takes place." In order for these three sets of statements to actually constitute an explanation of an event, they must fulfill at least two conditions: (1) the E statement must be deducible from the C and L statements together, and (2) the C and L statements must be true. Thus, a skeleton outline of a scientific explanation looks like this:

$$\begin{array}{c} L_1 \ldots\ldots\ldots L_n \\ C_1 \ldots\ldots\ldots C_n \\ \hline \therefore \qquad E \end{array}$$

It is a matter of some importance to notice that the logical structure of a scientific explanation is identical with the logical structure of a prediction. The only difference between explanation and prediction is the purely pragmatic one of the temporal vantage point or the particular interest of the inquirer. Thus, in the case of an explanation, we have--so to speak--our E, and seek the C's and L's under which to subsume it. In the case of a prediction, we have our C's and L's, and seek an E which they imply. From these considerations it follows that we have an explanation for an event, if and only if, we could have predicted it.

There are two other comments about explanation or prediction which are germane to our discussion. First, our use of lawlike statements is an indispensible prerequisite to the accomplishment of either explanation or prediction. Second, and associated with the first, we can now say with precision what we mean when we assert that it is the function of scientific theories to explain or to predict. In particular, such assertions mean that scientific theories lend the lawlike statements of which they are composed to deductions of the sort outlined above.

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Braithwaite's book is indispensible to anyone who has a serious interest in the problems associated with the logic of theory construction and the logic of statistical inference.

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This article is very closely related to the theme and content of this working paper.

Rudner, Richard S., "Some Problems of Sociological Theory." East Lansing, Michigan: Department of Philosophy, Michigan State University, 1961. Mimeographed, pp. 66.

This document is a discussion of various types of theoretical formulations in Social Science with emphasis on Parson's, "General Theory of Social Action." Copies may be obtained by writing to the author.

Learning-Behavior Theory and Education

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Theories of Learning and Behavior

Introduction

The scene in experimental psychology of learning has changed noticeably during the past quarter century. Simple mazes and stopwatches have been replaced by elaborate runways with electronic equipment to record behavior and to control reward conditions automatically. Earlier mechanical bar-pressing boxes now have relay racks of awesome programing equipment. Complex sequences of events can be controlled by computed programs, and the data may be submitted to computer analysis and simulation. Many learning psychologists are looking inside the organism and observing, producing, or controlling his behavior by direct electrical and chemical interventions. Overall, the layman touring the contemporary laboratory of learning is clearly impressed by the tangible trappings of science.

Learning and Behavior Theories

The change in the conceptual domain during this era has been less perspicuous. The handful of relatively well articulated learning theories, which dominated the field before the Second World War, have evolved into what are now often called, "behavior theories." This term emphasizes that learning is only one of the determinants of the behavior being studied. The term "behavior theory," however, suffers as much from being too general as does "learning theory" from being too specific. There are significant domains of human behavior about which these theories have little or nothing to say.

"Theory of learned behavior" is perhaps a more correct expression. It not only connotes that behavior is the object of interest. It also indicates that the data primarily considered by the theorist when building the theory were obtained from relatively simple learning situations. Personality theories, social theories, communication theories, and so forth, are also behavior theories. However, they were inspired by somewhat different areas of data.

The expansion of the scope of these learning and behavior theories has been accompanied by a loss of rigor, and by erosion of the lines of demarcation between them. They are now best thought of as theoretical approaches, their major role being to provide a language system or conceptual frame of reference within which to embed research.

By-and-large, earlier theories of learning or behavior have gravitated into one or two contemporary approaches: the relatively molecular, peripheral, mechanistic, stimulus-response approach; or the more molar, central, Gestalt, cognitive approach. My belief is that the differences between these approaches are more in the theorists than in the theories, and that they may ultimately be found to be isomorphic or very nearly so. In any event, this paper has been cast firmly in the stimulus-response mold because of my personal commitment to it.

Stimulus-Response Theory

Perhaps the best way to describe this conceptual approach is to quote several paragraphs intended for this purpose elsewhere. The *italics* have been inserted in order to emphasize our present concern:

Any learning situation is assumed to have three aspects: (a) learning the *stimuli* to respond to; (b) learning the *response* to make to those stimuli; and (c) learning the *optimal way* to make those responses. That is, the organism simultaneously acquires stimulus discriminations based on the qualitative and quantitative variations among the stimuli, and response differentiations based on the qualitative and quantitative variations among the responses.

The labels "quantitative" and "qualitative" are ambiguous. In the first place, it is often difficult to categorize definitively a variable as one or the other since some *qualitative* variations may be measurable and some *quantitative* variations may include differences in form. Furthermore, other dimensions, such as volume, tone, and expressions, may also be identified. The terms are intended to convey the entire range of possible variations among stimuli and responses, "quantitative" referring to the *intensity* dimensions of stimuli and to the *speed* and *vigor* dimensions of responses, and "qualitative" including all other features of stimuli which can serve as a basis for *discrimination* and all other features of responses which can serve as a basis for *differentiation*.

The subject's problem is to learn the optimal way to make the right response to the right stimulus. The scientist's problem is to predict how well the subject will do this on the basis of three sorts of information. The first may be called the *subject* conditions since the information concerns the species of subject, his state of health, drive, wakefulness, and any other characteristics that are relevant to his response potentialities. The second concerns the *learning* conditions, including prior learning history, number and distribution of trials, and specification of the relevant aspects of the stimulus situation. Finally, there are the *performance* conditions, which identify the reward and punishment contingencies in the situation, i.e., the consequences of making each possible response in each possible way to each available stimulus.

A completely empirical approach to these problems would be to sample every possible combination of subject, learning, and performance conditions. However, there are an infinite number of them. A large book could be filled with systematic descriptions of the possible conditions using a single apparatus, a single species, a single drive, and a single reward. The alternative approach is to theorize, to attempt to formulate, on the basis of a few observations, principles which can be successfully generalized to a wide range of untried conditions. Since we can never hope to have sampled more than a relatively small number of the possible conditions, the need for some theoretical statements is taken to be self-evident. The type of theory favored here is a stimulus-response (S-R) theory.

The dependent variable in scientific psychology is behavior--the objective "doings" of the organism. Responses must be the ultimate referent of any behavior theory regardless of its structure. An S-R theory makes the most direct assumption in this regard, namely, that responses are part of what the organism learns.

Typically, responses are not simply emitted; they occur to some stimulus configuration. If the evoking stimuli are freely available to the subject, then one can observe the rate at which the response occurs, but this in no wise alters the fact that the behavior takes place in some stimulus situations and not in others. An S-R theory assumes that the other part of what the subject learns is what stimuli to respond to.

These two parts are inseparably bound together. It is assumed that the organism does not learn responses independently of the stimuli to which he makes responses, and that he does not learn stimulus properties independently of the response he makes to stimuli. Thus, the organism learns to make particular patterns of vocal responses when stimulated by specifiable physical objects, utterances by others, and feedback cues from his own prior responses. Similarly, the organism learns to discriminate tables from chairs only in the sense that to one configuration of stimuli he learns responses (labeling, sitting on) and to another he learns other responses.

An S-R theory assumes that learning constitutes a bond, or connection, between a stimulus and a response. Behavior is predicted on the basis of response tendencies, that is, on the basis of the strengths of these connections.

It may be useful to discuss briefly the major constructs of S-R theory. There are five major constructs: habit, incentive, drive, effort, and inhibition. To be extremely informal for the moment, habit refers to how well the organism "knows" the response; incentive, to the consequences he "expects" for responding; drive, to how much he "wants" those consequences; effort, to how much work he "anticipates"; and inhibition, to how he "feels" at the moment. He will tend to respond to the extent that he knows how to respond and expects something he wants for responding; he will tend not to respond to the extent that it will require a lot of work and he feels tired or bored. The theory is an attempt to anchor these constructs to objective, empirical referents in the stimulus and antecedent conditions and to provide combination rules so that testable hypotheses can be deduced.

Learning Theory and the New Media

There are several additional preliminary remarks about the originally proposed topic of the possible role of learning theory as a conceptual base for research on the new educational media. First, it is believed that the newer and older media do not require different theories. The various media offer different opportunities to set up optimal conditions for the action of the principles of learning, but there is no reason to believe that the principles themselves differ. Hence, this paper has been addressed to education in general, although an attempt has been made occasionally to draw implications which differentiate among the various educational media.

Second, it has been taken for granted that the principles of learning determined in the laboratory are relevant to education. It could be argued that theoretical ideas based predominantly on the behavior of nonverbal organisms in simple learning situations will not apply in the complex educational setting, or at least, that any attempted application at this time is premature. Such reservations might be justified were one to use learning theory to direct educational practice, but so long as the focus is on research, the adequacy of any idea would be determined pragmatically.

Finally, it would be impractical and misleading to attempt to state a formal, explicit behavior theory from which one could derive theorems of interest to educators. In practice, learning theorists today tend to specialize on some single aspect of the larger theoretical approach and to do research centered on some component problem. The answers to all of these problems must ultimately be integrated into a comprehensive behavior theory.

Probably the best way to describe any particular contemporary theory is to give its stand on these and related matters. Several of these theoretical issues have been selected to illustrate the relevance of behavior theory to education. Specifically, it is proposed that ideas that are stimulating laboratory research can also stimulate research directed toward practical issues.

Strategy

The strategy of this paper will be: (a) to examine briefly some of the questions in which learning theorists are actively interested, and (b) to propose some of the possible implications of these questions for educational research. This strategy yields something of a potpourri of sentences collected around a few major theoretical constructs rather than a closely organized analysis of education in terms of learning theory. These sentences have not been screened to eliminate platitudinous and unrealistic ones, nor have they been polished to reflect all of their implications. Instead, an unabridged variety of relations between behavior theory and education have been sought with the hope that a few of them could be refined by interested people into concrete proposals for future work.

Reinforcement and Learning

Reinforcement: Positions and Definitions

One issue that has occupied learning theorists for a number of years is whether reinforcement is necessary for learning, for the accretion of habit. Ever since the original formulation of the law of effect, there has been controversy as to whether the associative connection between a stimulus and a response could be strengthened in the absence of reinforcement. As a result of this controversy, most stimulus-response psychologists now recognize the need for some form of reinforcement and the issue has become focused on disagreement as to the essential nature of such reinforcements.

Three of the more influential positions in this controversy define reinforcement as: (a) any change in the stimulus situation, (b) only decreases in stimulus intensity, and (c) only reductions in stimuli. It should be noted that the last one, which is often referred to as "the" reinforcement theory, is itself contained in the other formulations, and few psychologists would deny that drive and its reduction are effective means of producing learning.

There are difficulties with each of the above positions as well as with the less-well-known alternatives. However, each can, with ingenuity, be interpreted so as to be reasonably consonant with the facts. Nevertheless, the typical operating procedure is to define reinforcements functionally as events known to have the property of increasing the probability of responses which they follow. That is to say, since no independent characteristic has been discovered that can unequivocably identify reinforcing events, researchers concerned with systematic studies of the learning process are typically content to work with events (such as food to a hungry organism) known to function as reinforcers in past research. This procedure is, of course, formally circular in the defining instance since the occurrence of reinforcement is identified by the very process it is being invoked to explain. However, it is argued that the procedure is not circular provided one assumes that events that are identified as reinforcements in one situation will also have that property in other situations.

Reward as Reinforcement

It is difficult to identify the rewards in the typical educational setting. In practice, information about the correct response is assumed to occasion reinforcement and, in theory, presumably some form of learned reinforcement based on the reduction in the fear of social and parental disapproval is operative. A classroom is also a social interaction situation in which a variety of motives are operative, and some of these motives may be antithetical to educational objectives. The behavior theorist can contribute hypotheses and possible mechanisms on these matters, but not proven knowledge.

Reward in the New Media

It is probable that the various educational media differ in their reward potential. A teacher's approval may be more valuable than automatic correction, particularly insofar as fear of disapproval is involved. Motion pictures apparently have a unique captivating quality, although it is not always clear what response is being rewarded. One of the advantages correctly claimed for teaching machines is that they can give information immediately in relation to an individual student's performance. However, there are several reservations that should be appended to this important feature of automated learning. The fact that a machine can do something does not insure that it will actually do so. For example, there are often degrees of incorrectness that an either-or machine cannot discriminate. Furthermore, there are dimensions of reward other than its delay that are also important in determining its effectiveness. Furthermore, it simply does not follow *a priori* that getting some reward immediately is superior to getting a delayed, but larger, reward. Apart from theoretical interest, the compelling practical reason for identifying sources of reinforcement in the educational setting is to be able to utilize them more effectively.

This matter is particularly critical with the newer media in which the reinforcement must be programmed automatically without the intuitive skill of a teacher in person-to-person interaction with the student. Since a television program is insensitive to the responses of the viewer, immediate reinforcement as conventionally thought of is impossible. Accordingly, unusual attention must be paid to the possible distribution of viewers' responses so as somehow to provide the student with feedback information.

Rewards in Education

A final comment on the issue of the rewards in education may elicit strong objection from the purists. However, as a practical matter, quite a bit is known about how to motivate and reward people effectively. There is no reason why extrinsic rewards could not be used more extensively in the educational setting. Many schools already use some content-irrelevant rewards to motivate their students--most commonly, the withholding of privileges from the poor performer. A positive program would make items of real value available to teachers to produce added incentive for good scholastic performance. A program of this kind, especially if the standard fare of tools and toys were occasionally supplemented with items available only through the program, could--if properly administered--produce dramatic effects. Imagine, if you will, how many hours of study could have been bought if teachers rather than stores had dispensed hoola-hoops!

The reader may have paused on the phrase, "if properly administered," in the penultimate sentence of the preceding paragraph. It was included because an extrinsic reward system which simply amplifies the grading system is much less effective than one geared to take advantage of advancing knowledge of the effect of various schedules and conditions of reinforcement. For example, we not only know that organisms will continue to perform if reward is given irregularly. We also know that one unit of reward given every time is not always as good as two units of reward given half the time. The most generally effective conditions provide correlated reinforcement, that is, increased reward for improved performance. Such conditions are important because they enable one to teach quantitative details (such as how fast and how vigorously to respond) as well as the qualitative features of what response to make. With intrinsic rewards, one can do little but make two plus two equal four every time, but with extrinsic rewards, one can reinforce good performance in a variety of more effective and more efficient ways.

Stimulus: Definition and Issues

Stimulus Defined

It is perhaps surprising that a stimulus-response theorist cannot provide a fully adequate definition of the term, stimulus. However, no statement based on changes in physical energy has yet been formulated which can specify the events which are stimuli independently of behavior. This is primarily because any organism is receptive to only a small portion of the possible energies, and there is no physical discontinuity separating the effective from the ineffective ones. Furthermore, there are some properties, such as the relationship "prettier," which are difficult to identify in physical terms but to which responses can be learned. Accordingly, stimuli are defined functionally as properties or events which can serve as stimuli in S-R laws--following a procedure similar to that described in relation to defining reinforcements functionally.

The familiar perceptual phenomena such as contrast (for example, the apparent brightness of an object) varies with the brightness of the surrounding field, constancy (for example, the apparent size of an object tends to be the same at different distances from the observer), and so forth, make it clear that an environmental stimulus and its internal representation are not identical. The problem is how to reflect this fact theoretically. One solution is to assume a stable transformation equation that specifies the event-as-perceived in invariant relation to the event-as-it-occurred. That is to say, there may be determinate principles of perception which would enable one to infer the perceived event from knowledge of the observed event. An alternative solution is to posit a perceptual response which mediates the transformation and which is itself modifiable according to the laws of learning. If this approach is correct, the same objective event could be perceived in quite different ways by different people with different past experiences or current motivations. The hypothetical perceptual response is to be distinguished from receptor-orienting acts, the latter being overt peripheral responses which are certainly part of the stimulus-reception picture regardless of the approach taken toward perception as a covert, central process.

Areas of Research

There are several areas of research bearing on this controversy. Two of them will be mentioned here. First, it is a fact that a difficult discrimination may be learned in fewer total trials if the subject is first trained on an easier discrimination along the same dimension and then transferred to the more difficult one, than if all the training is given on the difficult one. This observation and several related ones are at least consistent with the notion that the distinctiveness among a group of stimuli can be enhanced by appropriate training procedures and hence that the stimulus side of an S-R event itself includes a modifiable process.

The general idea of graded difficulty is already an integral part of our educational system. However, there is a big difference between awareness of the values of graded difficulty and knowledge of the principles governing the optimal distribution of practice at different levels of difficulty. It is only probably true that a student should not be restrained on a simple problem after he has mastered it. It is possibly true that the difficulty level should be stepped up even before mastery of an earlier stage is complete. To pose this problem in the context of a medium such as a teaching machine, the programmer simply must make decisions as to the amount of time to spend on each phase of the task and the size of the increment to add at the end of each phase. Hopefully, there are determinate rules, rather than hunches, which could guide the scheduling of the various phases of each learning task as well as the order of the tasks themselves.

A second area of research concerned with the nature of the stimulus refers to the role of contextual stimuli in learning. Although it is conventional to refer to a specific event, or to a combination of events, as being the stimulus to which a response is learned: a stimulus, as so conceived, is embedded in a context which can be shown to have a bearing on performance. Not only can a subject learn one response to a specific stimulus in one context and a quite different response to that same specific stimulus in another context, but there is a demonstrable decrement in performance if the contextual environment is changed after training. This observation suggests that the stimulus complex must be thought of either as a "whole," or that each element in the stimulus complex must be somewhat modified by the coexistent elements.

Practical Implications

The foregoing findings have an important practical implication: Other things equal, performance will be better the closer the training conditions approximate the ultimate testing conditions. In this respect, teaching machines are probably the poorest educational medium since few of the practical problems which a person will encounter will arise in the context of a similar machine. In contrast, motion pictures can be used to create virtually any visual and auditory environment as a context for the learning task.

Since the stimulus is inseparable from the response, the problem of similarity of training and testing conditions will recur in the latter context. As a note of caution, however, the optimal arrangement of the contextual environment cannot always be deduced from available knowledge. For example, if a stenographer will ultimately have to take dictation in an environment including the noise of nearby office machines, then the shorthand teacher would be well advised, somewhere along the way, to include recorded sounds of this nature during the learning of shorthand. But since these sounds will also provide distraction that may interfere with learning, it may actually be best to introduce them gradually at some advanced stage of training. In this connection, it may come as something of a surprise to find that a student who learns somewhat less because he studies in his room with a radio playing actually performs somewhat better than the student who studies in a quiet library simply because what learning he has acquired is less susceptible to interference from distraction. The material for any educational medium should be designed with explicit attention to the nature of the situation toward which the training is being directed.

Response: Definition and Issues

Quantitative Variations

There are several issues in the general area of response definition which have potential significance for educational research. One such issue concerns the way in which quantitative variations in behavior should be treated. The classical view in this regard defines the response by its qualitative, topographical features, by a characterization of what the organism does. This viewpoint considers quantitative variations in speed or amplitude as measures, indices, or reflections of the strength of that response. For example, according to this position, one would say that a student learns the response of adding numbers, and that the better he has learned this response, the faster he can perform it.

The alternative view is that the quantitative dimensions of a response are themselves part of the defining characteristics of that response. For example, a fast response is not simply a stronger response than a slow one, it is a different response. According to this micromolar approach, as it has been called, all aspects of the response, qualitative and quantitative, are learned on the basis of the prevailing conditions of reinforcement. For example, speed increases with training only if faster speeds produce larger or more immediate rewards. Hence, one would say that the student learns not just the response of adding numbers, but the response of doing so at a particular speed. If this view is correct, then there would be a decrement in performance if the individual attempted to perform at a speed different from that to which he was accustomed.

The evidence on this issue is still not conclusive. It is clear that, if the reward is correlated with performance in such a way that the organism gets a bigger or more immediate reward when he performs at a particular speed or amplitude, then his performance will tend to converge to an optimal level. Abundant testimony supporting this position is available in familiar behavior ranging from the skilled speed of a golfer's swing to the widely-graded loudness with which we speak in various situations. However, the micromolar assertion that the organism always learns all properties of the reinforced response is not unequivocably demanded by the available data.

Notwithstanding the inconclusive state of knowledge on this issue, the likelihood that some kind of micromolar approach will be found to be necessary suggests the value of entertaining this possibility in educational research. Indeed, the fact that so many college freshmen, to say nothing of their parents and teachers, read appreciably slower than they are capable of doing, despite an enormous amount of practice, is at least consistent with the belief that they inadvertently learned to read slowly as a part of the common methods of teaching reading. If the micromolar view is correct, then attention should be given to all of the important properties of the response.

Even if the micromolar approach is not correct theoretically, the empirical fact that the quantitative dimensions of a response tend to become adjusted appropriately when the reward is correlated with the response suggests that these conditions can be used effectively to increase the level of performance. Specifically, for example, even if students can add faster the more they practice adding, regardless of practice speed, they can be trained to add still faster by effective correlated reinforcement. To be effective, the reward must be correlated with the individual's performance. Giving special rewards to the winners of occasional speed tests will probably affect only a few members of the typical heterogenous class. Most members of the class never win, hence they do not receive differential reinforcement for their better responses. Individual performance must be monitored and reward must be given in relation to individual past performance.

A correlated reinforcement procedure raises a by-now-familiar methodological problem: What is the optimal way to adjust the reinforcement criteria in relation to behavior? Certainly one should not start with very high standards which are out of reach of the student, nor with very low standards which permit success on every trial. Between these extremes, there is some optimal program that maintains an effective correlation between response and reward. Devising such a program, and the techniques to implement it, is a challenging task for research.

Identification of Behavior

Another problem within the context of the definition of the term response concerns the identification of behaviors which properly fall within this concept. Some psychologists, particularly those opposed to S-R interpretations, believe that the response concept must be restricted to peripheral, overt, muscular contractions and glandular secretions. It is possible that a comprehensive behavior theory can someday be constructed at this molecular level, and it is often useful to refer to this level to reduce ambiguities in the meanings of response terms. However, most learning theorists use more molar, generic response classes which are defined functionally. That is to say, behavioral events which obey S-R laws are treated as responses whether or not a unique physical referent can be identified.

Consider, for example, "paying attention." This concept may certainly include overt, peripheral aspects, such as orienting toward the source of stimulation. However, it also commonly implies covert aspects. "Paying attention" is usually treated as something which people either do or don't do Research in this area has been concerned mainly with determining the variables which affect whether an individual will pay attention to a particular stimulus. But, if attending is a learned response, the haphazard conditions of its acquisition may not always adequately prepare an individual to attend to educational material. Can the ability to attend to a message be improved by appropriate reinforcement conditions? Can attending itself be conditioned to novel stimuli? Is attending to auditory and visual input incompatible or complimentary? Can the ability to shift attention between two sources of input be improved? These are some of the questions raised if paying attention is correctly identified as a learnable response. These questions may be particularly important for those media which do not require a teacher's presence, and hence do not have this social pressure to attend to the message.

There are other possible responses which merit comparable treatment.

Thinking, for example, is something that parents and teachers constantly admonish children to stop to do, but little effort is directed at formally teaching people how to think. Insofar as thinking is an oral-verbal affair, recorded material would be ideally suited to giving directed practice in thinking. Listening to a message, as distinct from simply hearing sounds, may also be a learnable response. Unless the ear is an inherently poorer information input channel than the eye, the rate at which students can listen can be increased by training. If so, a two-hour lecture could be recorded, and then delivered in one hour as a way of coping with the ever-increasing wealth of information to be transmitted. In general, some of the fundamental activities in education might be as profitable objects of study by the newer media as the content of education itself.

Definition of Response

The content of education returns us to the problem of response definition, particularly as that issue concerns the identification of the learned response. Any specific behavior can be viewed as a member of a number of progressively more molar response classes, for example, a rat running a T-maze makes a specific molecular motor response sequence which can be described at a more molar level as turning left, or, at a still more molar level, as approaching the goal. These phrases are all legitimate descriptions of the behavior. But it makes a difference at which of these levels one assumes that learning occurs, because this assumption affects one's prediction of what the rat will do if the conditions are changed. The evidence on this issue suggests that learning is somewhat restricted to, and perhaps principally focused on, the molecular details of the reinforced performance and also that there are more widespread effects. The key to this problem probably lies in feedback: Learning tends to be general to behaviors producing similar internal and external feedback. However, explicating this solution has not yet been satisfactorily achieved.

This issue is perhaps the most fundamental one confronting educators. Just what has a student learned after repeating six times five equal thirty over and over to himself? Will he respond correctly when asked by his teacher for the produce of six and five? Will he write down "thirty," when he confronts that problem as a part of another problem? Will he correctly conclude that it will cost thirty cents to buy a half-dozen nickel candy bars? Will he incorrectly conclude that, if he and five of his friends each invite five people to a party, there will be thirty guests at the party? It is not a single question to ask whether a person knows the six-times table.

Corresponding to the theoretical question, "What is learned?" is the practical question, "What should be learned?" The relationship between these questions can be described this way: When an organism, be it a rat in the laboratory or a student in the classroom, is rewarded, there is an increased likelihood that he will make that specific response the next time that specific stimulus occurs. There is also a smaller increase in the likelihood that he will respond to similar stimuli and that he will make similar responses if the original one is blocked. The problem, "What is learned?" is the problem of anchoring "similarity" to objective referents so that the range of this generalization can be predicted. The problem, "What should be learned?" is the problem of specifying the range over which a generalization is appropriate--in the sense that the resulting behavior is correct. The practical problem, then, is to promote generalization where learning tends to be too narrow and to promote discrimination where learning tends to be too broad. But it is difficult to use behavior theory to help to design and to evaluate alternative conditions when the objectives are unclearly stated in a different language system. Accordingly, the major need is for an explicit theory of learning stated in objective, stimulus-response terms.

Conclusion

Research and Theory

Research is always guided to some extent by theory. The question is the extent to which that theory is relatively explicit and objective rather than informal and intuitive. Learning theory offers an active frame of reference which has proven effective in stimulating laboratory research.

There are so many possible critical reactions to the preceding comments that it would be virtually impossible to make anticipatory defenses against them all. The attempt has been to identify some possible relations between behavior theory and education and not to elaborate or to evaluate them. The writer shares any disappointment the reader may have that this endeavor did not produce a simple, comprehensive analysis of education in terms of learning theory, but in fact, the extent of potential relevance actually exceeded original expectations. Educational research workers can indeed profit from contemporary behavior theory.

However, for this integration to be achieved with maximal effectiveness, it is necessary that the major constructs in learning theory be anchored to observable, manipulable events in the educational setting. The principles of behavior employ terms such as stimulus, response, motivation, and reinforcement, and these terms must be identified and controlled if the principles themselves are to be of great practical value. Furthermore, the application of these principles must be directed by a reasonably explicit formulation of the goals of education in concrete terms. There is at least as great a need for concerted analytic activity as for research activity. Learning theory can provide useful guides for both activities.

Teacher Behavior

This final comment is not intended to invade the proper province of sociology. However, it should be recognized that a teacher is also a behaving (and learning) organism, subject to the same principles of behavior that apply to students. Many of the theoretical issues discussed in this paper could as well have been applied to the teacher as to the learner. For example, just as the most effective conditions of reinforcement for a student are ones in which greater reward is given the better his performance, so the most effective conditions for a teacher are ones in which differential success is differentially rewarded. Teachers must adopt and adapt to the new media. Their tendency to do so could be greatly increased, for example, if their income depended at least in part upon their skill in utilizing the various media at their command. At a more general level, it follows that across-the-board salary increases should be abandoned in favor of bonuses paid in proportion to a teacher's proven talent.

There is a seldom-recognized implication of Edison's famous statement, "There's a way to do it better," namely, "There's an even better way than that. . . ." The problem is not only to guide the research of the few individuals already engaged in this task, but to stimulate continuing research by the large number of teachers who collectively represent an enormous creative resource. In this way, the development and use of all educationa media will proceed most effectively.

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APPENDIX A

Additional Variables

The body of this paper dealt briefly with issues surrounding the major constructs: stimulus, response, and reinforcement. This appendix will deal even more briefly with other variables: habit, motivation, inhibition, nonreinforcement, and punishment. Even so, there are many topics in psychology of learning which will not be touched upon.

For example, there are problems concerned with the optimal amount of guidance, and with active participation. There are little-understood effects of "set" on learning and on problem solving. There is disagreement as to the implications of the fact that organisms can learn how to learn. There are many more provocative propositions--such as the possibility that there is a practical limit on how much an individual can learn and keep clearly discriminated. It would be unreasonable to try to service all of these areas. The remarks following are intended merely to suggest the flavor of the range of ideas which might be amplified into interesting educational research.

Habit

The issue of the rule of reinforcement in learning which was discussed previously is relevant to all three of the positive determinants of response tendency--habit, drive, and incentive. Apart from the questions of whether reinforcement is necessary for the acquisition of habit, and whether drive reduction is the only form of reinforcement, motivation and reward are both essential for performance through their energizing roles as drive and incentive. Furthermore, they may have indirect effects on learning. For example, a motivated individual is more likely to expose himself to opportunities for learning. An excellent adult educational television program is of no value unless the response of tuning in the appropriate channel is stronger than that of competing activities. The motivated person is more likely to be in the learning situation and to profit from his experiences there.

A more specific issue about habit concerns the manner of its growth. The most familiar view of learning is reflected in the saying, "Practice makes perfect." That is to say, it is generally believed that learning is a gradual, cumulative process in which a response gets progressively stronger with repetition. The alternative position that learning is all-or-none in character has received renewed impetus during the past few years. Of course, the performance of complex response chains improves gradually, but it is possible that elemental components are acquired in one trial. At least, some forms of human verbal learning can be adequately described on the assumption that an item is either learned or not learned on a particular trial and that there are no intermediate stages in the process.

There may be other sorts of value in repetition. The generality of a learned response may be increased and its susceptibility to forgetting may be decreased. These considerations jointly suggest a training procedure in which early trials are specifically designed to get the association formed as quickly as possible. Later trials are somewhat differently designed to promote generalization and retention. Experimental data suggest that, toward the former goal, trials probably should be widely distributed with rigidly controlled conditions. Toward the latter goal, trials probably should be given under irregular conditions. In any event, it may be inefficient to concentrate upon drill-like rehearsal. It may be incorrect to leave material before learning is manifest on the assumption that some learning will have occurred during the practice given.

There are other issues concerning habit which can only be mentioned here. Does habit reach an asymptote or does learning continue even after performance has reached a stable level? Is habit permanent or can it be lost through disuse? Do some habits, particularly those based on positive reward, generalize more widely than others, particularly those based on punishment? Can habit be formed even if the overt response involved does not occur during original training? There are data in the psychological literature bearing on these and on other such questions and each has implications which could be drawn for educational research.

Motivation

The major issue concerning the other positive components of response tendency, drive and incentive, is the extent to which the energizing property of these variables is restricted to habits acquired in their presence. But before discussing this issue, let us consider the more fundamental problem of separating these components in complex human behavior. The distinction can be drawn most easily in the laboratory setting: An animal's drive may be hunger produced by deprivation of food, and his incentive may result from past experiences with food at the end of a runway. These components or factors can be manipulated independently with comparable effects on behavior. One can make the rat run faster by depriving him of food for a longer period of time and hence increase his drive; or by training him with a larger amount of food at the goal and hence increase his incentive. Furthermore, if these variables interact multiplicatively, as some learning theorists believe, the effect of increasing incentive will be greater the higher the prevailing level of drive. Or conversely, increasing incentive may have little effect on an organism operating under low drive.

Consider now a human example, say attempting to increase a child's motivation to learn by offering him money for good grades. "Drive" is the desire for money. It may be brought to bear by the offer, but its intensity is independent of the offer and dependent upon the child's past experiences with (and without) money and his present state of solvency. "Incentive," in popular parlance, refers to the preferred money itself, but incentive as a theoretical construct in behavior theory refers to an internalization of the reward--including probability of occurrence. That is to say, an offer of money produces incentive in proportion to the size of the offer and the likelihood that it can be attained. An offer of ten dollars for a B-average may produce more incentive than an offer of one hundred dollars for an A-average. If a child's wants are otherwise satisfied so that he has no need for money, even an optimally adjusted offer will not induce him to study. If the offer is out of proportion to his past experience of success (as distinct from an adult's perception of the child's potential), it will not be effective even if the child is sorely deprived.

The further application of these ideas to education requires some assumption about the motive-reward condition involved. Suppose, for example, that knowledge is intrinsically reinforcing in relation to some underlying curiosity drive. Among the questions then raised are: Can a person's curiosity be increased in a manner analogous to the way hunger can be increased, i.e., by depriving him of knowledge? Can special programs be prepared to increase incentive above the level induced by typical programs, i.e., to provide experience of success for the typically poor performer? In general, what variables affect the intensity of this drive and the amount of this reinforcement so that they can be manipulated?

Insofar as their energizing properties are concerned, drive and incentive could be specific to those habits acquired in their presence, or they could be general and able to motivate any behavior. This issue is clearly relevant to any practical learning situation. If the former alternative is true, training must be conducted under the same motivating conditions which will prevail during subsequent performance. Fortunately from this point of view, the evidence suggests that drive, at least, is general and that training conducted under one drive can be utilized under another drive. However, there is also reason to believe that this generality is not completely unlimited, and hence that ideal training conditions should take into consideration the ultimate conditions of motivation.

Temporary Inhibition

The negative factors in response tendency that oppose habit, drive, and incentive and lead to a lower level of performance have received relatively little attention. Of course, education is concerned more with the acquisition of knowledge than with its removal, but there are occasions when a student has wrong habits based on prior experiences which must be eliminated if the correct habits are to be learned. Furthermore, insofar as education is directed at producing stable and persistent behavior, the forces acting to eradicate learning should be considered when devising a training program.

The flavor of the difficulties in this area can perhaps be conveyed by simply reciting some of the questions involved. Is forgetting a fundamentally different process from experimental extinction, the former pertaining to loss in performance over time while the latter pertains to the loss in performance resulting from nonreinforced occurrences of the response? Is the frustration produced by nonreinforcement motivating and, if so, can this drive be used to facilitate performance? Does punishment eliminate responses permanently, or does it only suppress overt behavior temporarily? Is the law of least effort valid, or can differential effects of work be accounted for in terms of differences in the nature of the response? Is learning to inhibit a response similar in kind to learning to make a response? Is the alternation tendency based on response factors or on stimulus factors? Can the effects of nonreinforcement and punishment be accounted for entirely on the basis of counter-conditioning, or do they directly reduce response tendency? Let us elaborate briefly on the last two of these questions.

All educators are familiar with the temporary inhibition, resulting from fatigue or boredom, which opposes continued performance. The theoretical issue is whether this alternation tendency is centered on the response, so that the organism tires of doing the same thing repeatedly; or on the stimulus, so that he satiates on being in the same situation repeatedly. Actually, the latter implies the former, provided that one recognizes that feedback cues from the response are also the ones on which the organism can become satiated. However, probably the best description of the available data is that there are alternation tendencies on both bases. Accordingly, any educational program should be designed to include enough variety to minimize inhibition from these sources, but it will require a substantial amount of research to determine the ideal design in this respect.

Nonreinforcement and Punishment

Nonreinforcement and punishment lead to more lasting decrements in performance than fatigue and boredom, but it is possible that these factors--rather than reducing response tendency--affect behavior through the competing responses they produce. To illustrate with punishment, the response elicited by a noxious stimulus will tend to occur in anticipation of the punishment and to supersede the punished response. According to this position, it is essential that the punishment suit the crime--in the sense that it elicit incompatible behavior. Trying to teach a dog not to chase cars by shooting him from behind with a BB gun is doomed to failure because the pain elicits more running, whereas shooting him from in front with a water pistol will work because it stops the ongoing running response.

The alternative position is that punishment can act directly to inhibit a response. It should be noted that this alternative does not completely discount the importance of counterconditioning. Indeed, it implies that a punishment that evokes a competing response will be more effective than one which evokes behavior compatible with the punished response--although the latter may also be successful in eliminating undesirable behavior.

Again, let me simply recite some sentences suggested by these considerations. Grades, as typically given, may be reasonably effective reinforcers for the good performer, but they are relatively ineffective for the poor performer because they punish his responses without necessarily eliciting the correct responses. Part of the advantage of teaching machines over other media is the requirement that any errors which happen to occur be corrected immediately. Possibly, special remedial programs should be devised for all media, since the problem of teaching a student who has learned some incorrect responses is different from that of teaching a student with no prior learning in the area. The latter can be shaped into the correct responses substantially without errors, whereas the former may benefit from making errors and correcting them. It is probably unnecessary to point out that many teachers spend as much time dealing with behavior problems as they do teaching. The application of some of the new, powerful media to corrective education would make a truly important contribution.

APPENDIX B

Theory-Based Research

Research is a multi-stage process. The foregoing remarks have been aimed at the early stage of identifying potentially important problem areas for research. The purpose of this appendix is to illustrate how learning theory can also be useful at the subsequent stage of planning detailed, systematic research studies.

The type of problem most frequently encountered in a practical situation is the determination of the optimal schedule or arrangement of conditions. For example, the fact that a difficult discrimination may be learned in fewer total trials if some training is first given on an easier discrimination along the same continuum poses the methodological problem of determining the best sequence. One approach to this problem is to undertake extensive, methodical research. The alternative is to devise a learning model from which the effects of various sequences can be deduced and to concentrate research on testing the model.

To illustrate the latter approach, I have taken the fundamental assumptions of the theory of discrimination learning formulated by Spence in 1936, and calculated the course of learning under several different trial sequences. Doing so requires setting up a number of hypothetical conditions and illustrative equations and hence this proof is not proposed as being general. It is interesting to note, however, that the finding which so directly seems to imply that a cue dimension somehow acquires perceptual distinctiveness as a result of discrimination training, can be deduced from a model which does not make such an assumption.

Testing a Model

Let us assume a continuum with 100 equally-spaced stimuli. Each stimulus can be identified by a number corresponding to its position on this continuum. We shall assume that the ultimate discrimination of interest is between S45 (negative) and S55 (positive). For simplicity of comparative computation, every odd-numbered trial is reinforced to a positive stimulus (being S55 or higher) and every even-numbered trial is nonreinforced to a negative stimulus (being S45 or lower).

The four schedules examined are: (a) all positive trials to S55 and all negative trials to S45, i.e., training exclusively on the ultimate discrimination; (b) positive trials starting at S78 and decreasing by one step on each trial; and negative trials starting on S23 and increasing by one step on each such trial, i.e., starting on an easy discrimination and moving progressively toward the ultimate discrimination; (c) positive trials and all negative trials to S45, i.e., starting on an easy discrimination at the same rate as in "b" but only involves changes in the positive stimulus; and (d) all positive trials on S55 and negative trials starting on S1 and increasing by two steps on each such trial, i.e., the same as "c" except keeping the positive stimulus unchanged.

The postulates of the model follow: (a) a reinforced trial produces an increment in habit (H) between that stimulus and the response according to the equation, delta H = .1 (1-H); (b) a nonreinforced trial produces an increment in inhibition (I) between that stimulus and the response according to the equation, delta I = .1 (H-I); (c) any increment to H at one stimulus (Sx) generalizes to similar stimuli (Sy) according to the function,

$$\text{delta Hy} = \text{delta Hx} \left[\frac{60 - |Sx - Sy|}{60}\right]^{\frac{1}{2}}$$; (d) any increment in I

generalizes according to the same function as given in "c"; (e) the excitation potential (E) for a stimulus to evoke the response is defined as, E = H - I; and, (f) discrimination is measured in terms of the difference between the E of the positive and negative stimuli.

The implications of this model over the first 24 trials for the four schedules are displayed in Table 1, below. It can be seen that the model correctly implies an advantage of starting with an easy discrimination that is symmetrical around the ultimate discrimination, i.e., b > a. Furthermore, a still better procedure is to start with an easy discrimination such that the ultimate negative stimulus is used throughout, i.e., c > b. The converse procedure of starting with an easy discrimination such that the ultimate positive stimulus is used throughout yields a result virtually identical to "a." Hence, if this model is correct, the rate of learning a discrimination depends importantly upon the sequence of stimuli used.

TABLE 1

Differences between the Excitation Potential of the Fifty-Fifth and the Forty-Fifth Stimuli over the Four Sequences of Trials Described in the Text

After Trial Number	Sequence a	Sequence b	Sequence c	Sequence d
4	.019	.022	.038	.019
8	.037	.042	.066	.037
12	.054	.059	.088	.053
16	.069	.076	.105	.068
20	.084	.092	.121	.082
24	.096	.103	.134	.095

APPENDIX C

Laboratory and Classroom

Although education was affected by psychologists of an earlier era--notably by Dewey, McDougal, Thorndike, and Watson--there has been relatively little effort devoted to keeping a bridge between the learning laboratory and the classroom. May (e.g., 1946) has probably been most consistent in attempting to maintain this contact.

Recently, Miller (1957) has made a fairly detailed analysis of graphic communication from the point of view of the principles of learning. Melton, Spence, and Underwood (1959) collaborated in a provocative symposium addressed to the general relationship between the psychology of learning and education. Most recently, Meierhenry (1961) has edited a collection of interesting papers by Deese, Glaser, Kendler, Luchins, McDonald, and Postman, all dealing with audio-visual aids in relation to learning theory.

The greatest impact to date has come from Skinner (e.g., 1958) with the development of techniques of automated learning. This field has already amassed an impressive bibliography of its own.

All of the articles mentioned are of high caliber. Collectively, they represent a comprehensive overview of contemporary learning theory and its possible significance for education. To them, the present paper adds a somewhat greater emphasis on the fundamental problem within learning theory: the problem of adequately defining basic terms such as "response." In general, there is a comfortable amount of agreement and overlap in the various approaches. Anyone seriously interested in this area should certainly study them all.

These citations from the literature are given in full in the bibliography (pp. 76-77).

Communication Theory and the Use of the New Media

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Nature and Origin of the Problem

Introduction

A clear impression of any theory requires some consideration of the discipline fostering and nurturing it. To learn some of the reasons for the present state of learning theory, we can consult psychology; for social theory, we go to sociology; and for epistemological theory we turn to philosophy. To look at communication theory today, we must look in areas seemingly unrelated to communication. The communication theorist can point to psychology, sociology, philosophy, physics, mathematics, rhetoric, and to linguistics as only a few of the places in which the antecedents of his theory are found.

Concern with the nature, quality, and function of human communication is probably as old as man. For centuries, the study of communication was to be found in rhetoric, literature, or drama. The study of certain aspects of human communication is still to be found in these disciplines. In addition, scholars from departments of psychology, sociology, linguistics, political science, and anthropology also admit to being very much interested in certain aspects of human communication. And it takes very little pushing to obtain an admission of interest in communication from the physicist, the philosopher, the biologist, and the engineer.

In spite of this widespread interest in phenomena of human communication, the study of communication as a scientific and professional field administratively located within separate academic departments so labeled is new. It arrived on the academic scene within the past two decades. Argument is still heard over the question of what communication is, and relatively little has yet been accomplished toward answering theoretical questions concerning the nature of the process. Almost everyone agrees that the new media are closely linked to the communication process, however it may function. Our only problem is finding theory to explain this linkage.

In this paper, I would like to expand several propositions concerning the relationship of communication to the new media and to education. The first proposition suggests that a concern with the new media arises out of roots common to both communication and education. Second, although much concern has been exercised over the production of visual or verbal descriptions of the communication process, little concern has been devoted to the place of the new media in these descriptions of the communication process. Third, I suggest that at least one fruitful approach to certain educational problems derives from a consideration of balance theory and communication.

Origins of the Problem

We can exemplify our first proposition by taking a short historical tour. In rhetoric, in literature, and in drama, major emphasis has always been placed on the source of communication. The speaker, the writer, and the actor are studied in great detail. Some concern has always existed for the listener, the reader, and the audience, but such concern was usually secondary and peripheral. Frequently, the research methodology in these areas has been historiography. From this tradition have come many fine studies of great speakers, great writers, great newspapers, and great actors. Many departments and individual scholars carry on this tradition today.

An emphasis on the total process of communication, with particular attention to the receiver of communication, is relatively new. The increased interest in communication behavior has its roots in the nineteenth century. On the philosophical side, all of the behavioral sciences show the effects of a revolt against scholasticism and monasticism in science and in mechanics. New phenomena, new theory, and new methodology have come onto the scene. The experimental method has taken over in psychology and other social disciplines. Communication research and theory today inherit the fruits of this revolution.

A second set of roots stems from the industrial revolution. The ability of man to mass-produce newspapers, books, and magazines heralded the dawn of an Age of Communication. The rise in population together with the invention of radio and television meant the development of advertising, of merchandising, of transportation, and indeed of many facets of our daily lives. It is impossible to separate these factors in terms of importance, but their influence on communication is undenied. We have seen new audiences, new sources, new sets of messages, and new academic departments arise as a result of these discoveries.

The communication researcher may be interested in the nature of the source as the source relates to the subject or content of a particular message. He may study the characteristics of receivers of particular kinds of messages. He may look at the kinds of receivers electing to read a particular newspaper. He may be interested in the effect of a particular psychological variable on communication reception. Any of these concerns, and many others, are legitimate areas of research on communication.

It is a truism to suggest that communication and education must go hand in hand. It is difficult to conceive of being able to educate without being able to communicate. Many of the concerns that have faced the communication researcher have also faced the educational researcher. The educational theorist has benefited from the revolution in the behavioral sciences in the same ways as his counterpart in communication.

One of the most flourishing areas of study for both communication and education has been the "new media." Many of the media are not new, but recognition of their usefulness in education is relatively new. Research on the differential effects of these media is even newer.

An exhaustive list of the new media is impossible, but certainly we would include radio, television, movies, books, film strips, slides, models, and drawings. And, most recently, I suspect that most of us would like to add the "teaching machine" to this list.

Research on the media of communication has been conducted at several levels. The physiology of vision, of hearing, of touch, of taste, and of smell have been rather extensively investigated. Psychologists have studied the perceptual processes of the organism under various learning conditions, various anxiety states, different attitudinal conditions, and differing drive states. The sociologist has looked at perception as it is influenced by culture. The sociologist also has been interested in the development of taste and culture as influenced by the media. The economist has been interested in the distribution patterns of messages created by the use of different media. Other disciplines could add their interests to this list. The point is, of course, that an interest in the new media is not confined to either communication or to education. Useful material and fruitful approaches to the study of the new media are to be found in many areas. The roots of our varied interests are to be found in the same series of prior events.

Communication Theory and the New Media

Despite the existence of flourishing schools of communication, of large numbers of graduate students, and of large research budgets, we do not today have a distinctive communication theory. Neither do we have a distinctive theory in which communication and the new media are brought together. Whether or not this state of affairs is a desirable one remains to be seen.

Theories and Models in Communication

I do not use the term theory to refer to statements purporting to explain some small fact examined in isolation. By a theory, I mean a set of propositions or statements intended to cover many aspects of behavior. A theory is a well-coordinated conceptual system. Typically, the existence of a theory allows the generation of theorems whose testing tends to confirm the theory itself.

There are at least two reasons for the lack of a distinctive communication theory today. One reason is that individuals interested in human communication have tended to come to a study of the communication process from disciplines where some theory is already present. Thus, we have many studies in which learning theory, social theory, group theory, or balance theory have been applied to communication problems. A second reason lies in the relative newness of rigorous investigation of the variables in the communication situation. In a rigorous sense theory usually comes after the phenomena which the theory attempts to explain are well described. The task of describing the process of human communication is far from complete. The term communication theory has been used as synonymous with a description of the process of communication. The production of numerous heuristic visualizations of the elements of the communication process has occupied the time of many scholars.

A look at some of these descriptions of the communication process gives an indication of the fertile fields available in communication research. We can refer to these efforts as attempts at constructing models of the process of communication.

Scientists use the term model in different ways. Sometimes it is substituted for terms like theory, analogy, hypothesis, and flow chart. It is given a very rigorous definition by one individual, and used very loosely by another. In the area of communication theory and process, the student soon finds himself surrounded by a rather confusing variety of definitions, charts, and sets of mathematical symbols. All are referred to as models of the communication process. None seem to fit the rigorous requirements suggested by Professor Rudner in defining a model.

Another way of looking at the study of communication is to look at the different levels at which one can approach the study of a set of phenomena. At one level, we can attempt to describe the phenomena and to indicate approaches to the study of the phenomena. All of the visualizations which are discussed in this paper are of this nature. They are essentially descriptive in nature, and heuristic in their indication of useful ways of looking at communication situations.

At a different level, we can attempt to operationalize the elements of the description or visualization in such a way that measurement operations and predictions become possible. In communication, perhaps, the closest we can come to operationalization is through the mathematical formulations of information theory. Other attempts to operationalize some of the phenomena in human communication situations have been made through the use of learning theory as a basis for predicting message retention, and balance theory as a basis for predicting attitude change on the part of communication receivers.

At an entirely different level, we can attempt to develop a full-blown functional model. A functional model is not necessarily descriptive, but it specifies certain relationships among elements of a process in such a way that new relationships or propositions can be generated from the model itself. There are no functional models of the communication process. It may be questioned whether or not functional models exist in any of the behavioral sciences.

Any visualization, model, flow chart or set of symbols represents a substitution for the "real" phenomena. If perfect, a model or visualization of the communication process would show all possible aspects of the actual process of human communication. It would thus have perfect fidelity. Another way of putting it is to suggest that the parts of the model would correspond in an exact one-to-one relationship with the process as it exists in the real world. That is, the model would be isomorphic. The limitations of the graphic arts, and the imposition of stasis that visualization carries, mean that dynamic, ongoing processes cannot be represented with perfect fidelity. If fidelity cannot be considered a criterion for evaluation of a description of the communication process, the heuristic purpose of most of these graphic representations suggests that utility be considered the main criterion. A criterion of utility applied to the models we shall discuss below indicates rather clearly that the new media have received little attention from those interested in describing the communication process. We shall see that one author would consider newspapers, television, movies, etc., a source variable in the communication process. Another author would see these media as channels. However, most of the authors do not mention the place of the media within the process. This may not diminish the value of particular models for situations where media use is not a consideration, but it does make it difficult to talk about communication theory and the use of the new media in education.

Perhaps the simplest description of the communication process is also one of the oldest. Aristotle divided the study of oral communication into a consideration of the speaker, the speech, and the audience [1]*. However, Aristotle did not consider media, nor mention the concept of channel. Even today, Theodore Newcomb, for example, ignores the channel or medium as a necessary element in communication when he suggests that one of the simplest of communication situations occurs when individual A talks to individual B about some object or concept X [2]*. Again the new media are ignored in the A-to-B-re-X situation.

Speaker-Listener Model of Communication

From Aristotle to the present there is a span of some 2300 years. However, Aristotle's influence on communication theory is felt today. Certainly the model of communication produced by Bryant and Wallace (Figure 1, following) owes something to classical theory [3]. The orientation of Bryant and Wallace is to the polarized speaker-audience situation. The elements of the process which they identify emphasize a psychological approach based on motivations, attitudes, feelings, etc. Their model attempts to show the process nature of communication, with particular attention to the part played by feedback. However, channel is not recognized as an important element, and the "new media" are completely ignored.

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*The numbers in brackets refer to items on the numbered list, "References," given at the end of this paper.

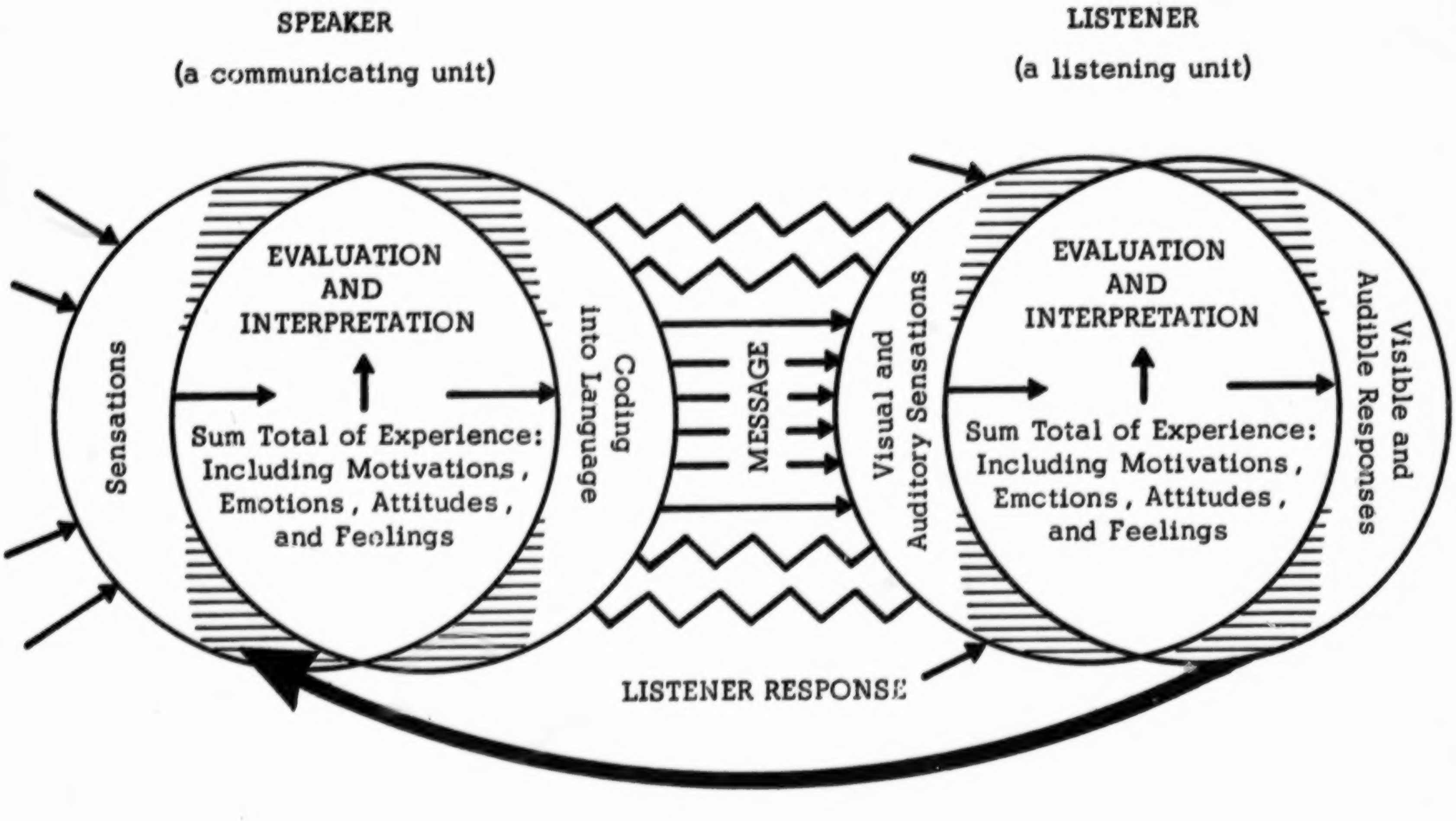

SPEAKER
(a communicating unit)
LISTENER
(a listening unit)
Sensations
EVALUATION AND INTERPRETATION
Sum Total of Experience: Including Motivations, Emotions, Attitudes, and Feelings
Coding into Language
MESSAGE
Visual and Auditory Sensations
EVALUATION AND INTERPRETATION
Sum Total of Experience: Including Motivations, Emctions, Attitudes, and Feelings
Visible and Audible Responses
LISTENER RESPONSE

Figure 1.--Psychological Model of Communication by Donald C. Bryant and Karl R. Wallace [3].

Mechanical Model of Communication

Perhaps the best known model of the communication process (Figure 2, following) is the one which forms the basis of Shannon and Weaver's book, The Mathematical Theory of Communication [4]. Because Shannon's definitions of the elements of the process as he saw them are rather precise, I repeat his entire statement here:

> By a communication system we mean a system of the type indicated in Figure 2. It consists of essentially five parts:
>
> 1. An information source which produces a message or a sequence of messages to be communicated to the receiving terminal. The message may be of various types: (a) a sequence of letters as in a telegraph or teletype system; (b) a single function of time f(t) as in radio or telephony; (c) a function of time and other variables as in black and white television--here the message may be thought of as a function f(x, y, t) of two space coordinates and time, the light intensity at point (x, y) and time (t) on a pickup tube plate; (d) two or more functions of time, say f(t), g(t), h(t)--this is the case in "three dimensional" sound transmission, or if the system is intended to service several individual channels in multiplex; (e) several functions of several variables--in color television the message consists of three functions f(x, y, t), g(x, y, t), h(x, y, t) defined in a three dimensional continuum--we may also think of these three functions as components of a vector field defined in the region--similarly, several black and white television sources would produce "messages" consisting of a number of functions of three variables; (f) various combinations also occur, for example, in television with an associated audio channel.
>
> 2. A transmitter which operates on the message in some way to produce a signal suitable for transmission over the channel. In telephony this operation consists merely of changing sound pressure into a proportional electrical current. In telegraphy we have an encoding operation which produces a a sequence of dots, dashes, and spaces on the channel corresponding to the message. In a multiplex PCM system the different speech functions must be sampled, compressed,

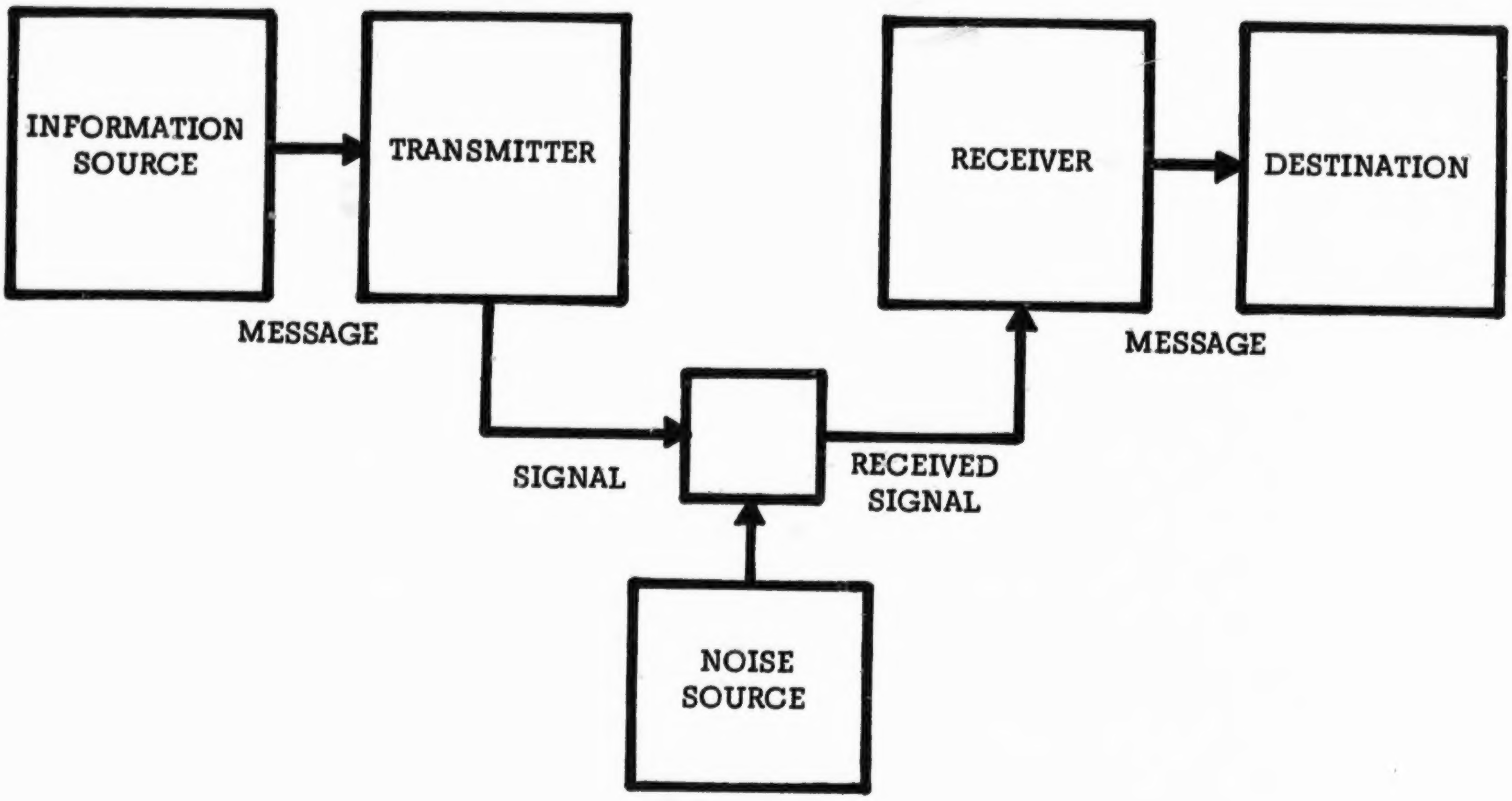

INFORMATION SOURCE
TRANSMITTER
RECEIVER
DESTINATION
MESSAGE
MESSAGE
SIGNAL
RECEIVED SIGNAL
NOISE SOURCE

Figure 2.--Visualization of the Process of Communication by Claude E. Shannon and Warren Weaver [4].

quantized and encoded, and finally interleaved properly to construct the signal. Vocoder systems, television, and frequency modulation are other examples of complex operations applied to the message to obtain the signal.

3. The channel is merely the medium used to transmit the signal from the transmitter to receiver. It may be a pair of wires, a coaxial cable, a band of radio frequencies, a beam of light, etc. During transmission, or at one of the terminals, the signal may be disturbed by noise. This is indicated schematically in Figure 2 by the noise source acting on the transmitted signal to produce the received signal.

4. The receiver ordinarily performs the inverse operation of that done by the transmitter, reconstructing the message from the signal.

5. The destination is the person (or thing) for whom the message is intended.

Shannon and Weaver were not particularly interested in psychological aspects of communication, nor was their orientation or purpose sociological, philosophical, or educational in nature. They are not even specifically interested in restricting their interests to human communication. Their diagram with its accompanying text makes no attempt to look at the "new media" as separate or distinct elements of the communication process. Rather, the media are described under source and message, and the focus is not on the media as such.

Speaker-Audience Model of Communication

A visualization which has all the elements of the Shannon and Weaver model, but which combines them with emphasis on the cognitive processes of human communication, is the model (Figure 3, following) developed by Halbert E. Gulley [5]. In Figure 3 we see another attempt to emphasize the process nature of communication, but with no apparent emphasis on the role of the media in communication.

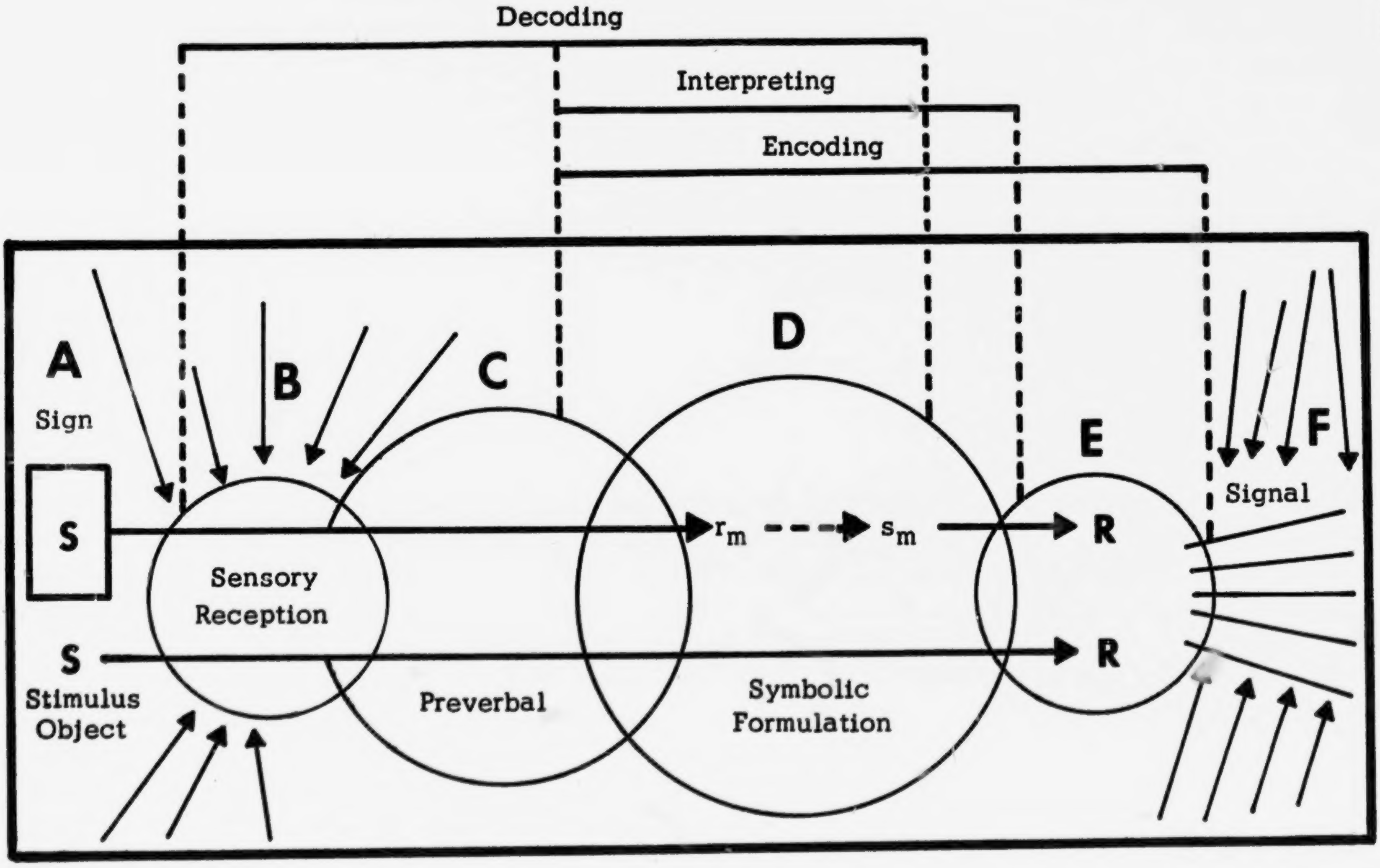

Decoding
Interpreting
Encoding
A
Sign
S
S
Stimulus
Object
B
Sensory
Reception
C
Preverbal
D
r_m
s_m
Symbolic
Formulation
E
R
R
F
Signal

Figure 3.--The Process of a Speaker Addressing an Audience by Halbert E. Gulley [5].

S-M-C-R Model of Communication

Some researchers interested in human communication have analyzed the communication process from the standpoint of psychological factors which might affect the source and receiver in any situation. David K. Berlo looks at communication factors under the four rubrics of source, message, channel, and receiver (Figure 4, following), and suggests some of the relevant variables under each rubric [6]. Figure 4 also suggests a breakdown of communication channels into the five most important senses. However, Berlo's source-message-channel-receiver model does not emphasize the new media of communication, nor does it attempt to indicate the relationship of channel to these media. It can be argued that consideration of this visualization leads to an assignment of the new media to either the message or to the channel rubric. This model might also suggest that it may not be profitable to look at the new media at all--if the total communication process is not to be taken into consideration at the same time.

Psychological Model of Communication

A diagram representing a somewhat different orientation to communication is presented in Figure 5, following. Carl Hovland and his associates classified the factors responsible for attitude change produced by social communication [7]. The framework for the model is drawn from psychology. The media are considered to be one form of observable communication stimuli. We could easily translate the model to suggest that television, movies, teaching machines, etc., form part of the stimulus field for the student who views them in a teaching situation. It seems to me that the Hovland visualization presents an extremely useful framework for psychologically-oriented communication research.

Perception Model of Communication

Westley and MacLean have developed a conceptual model of communication specifically aimed at directing research in this area [8]. Figure 6, following, shows their model in four different stages. In total, their model emphasizes the role of perception in communication, and points up the importance of the "intermediate source" in the communication process.

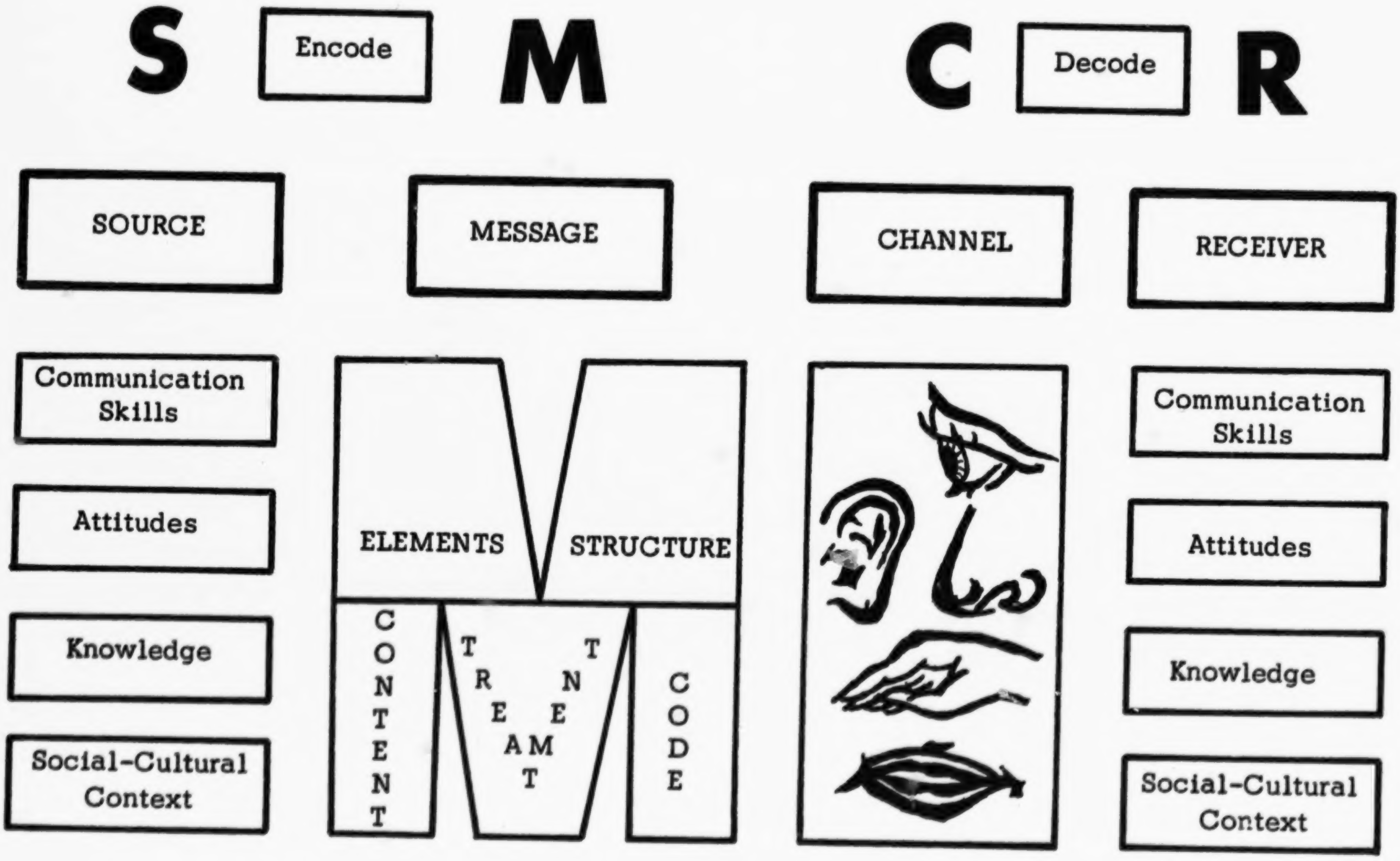

S
Encode
M
C
Decode
R
SOURCE
MESSAGE
CHANNEL
RECEIVER
Communication Skills
Attitudes
Knowledge
Social-Cultural Context
ELEMENTS
STRUCTURE
CONTENT
TREATMENT
CODE
Communication Skills
Attitudes
Knowledge
Social-Cultural Context

Figure 4.--Source-Message-Channel-Receiver Model of Communication by David K. Berlo [6].

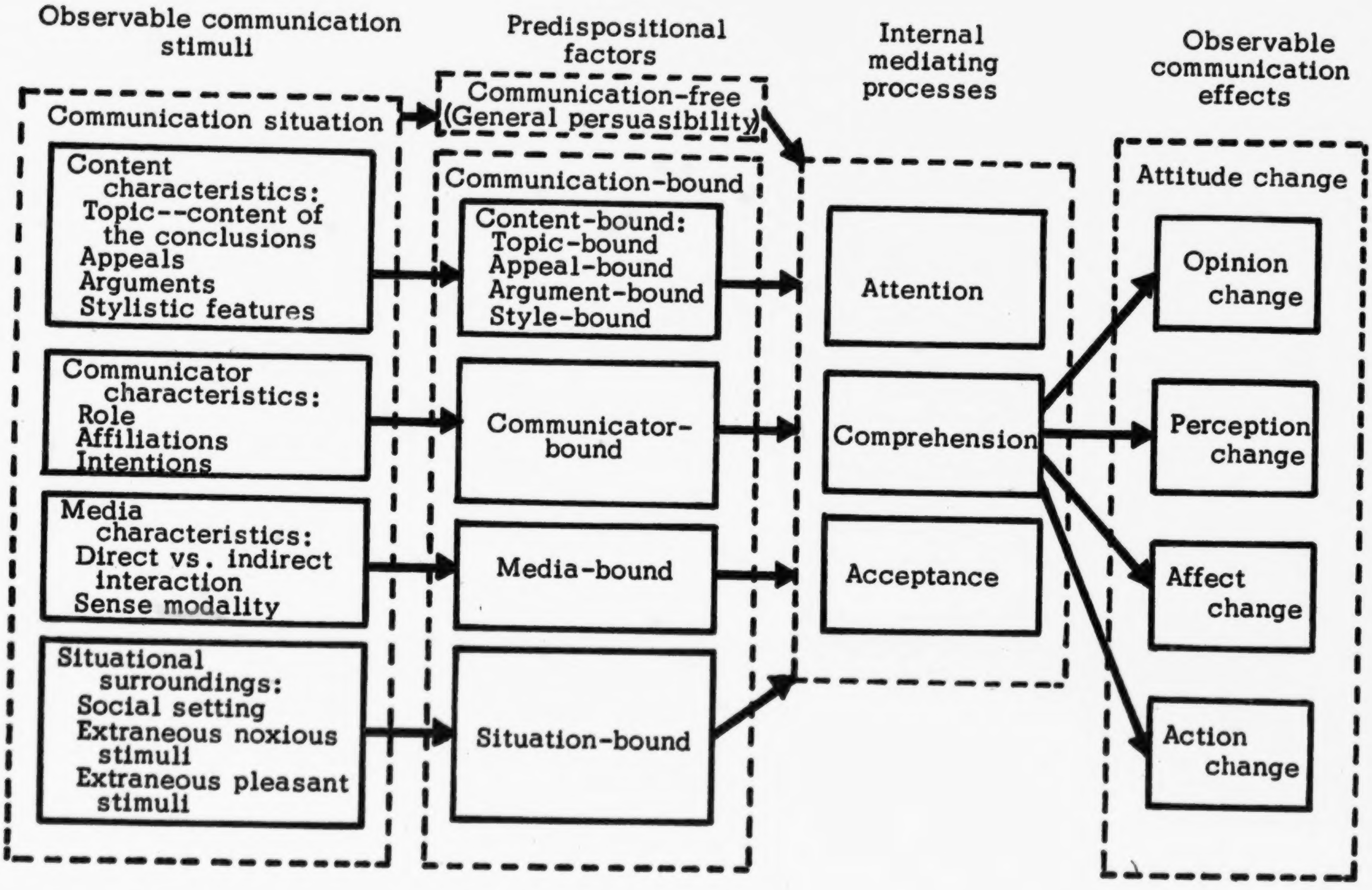
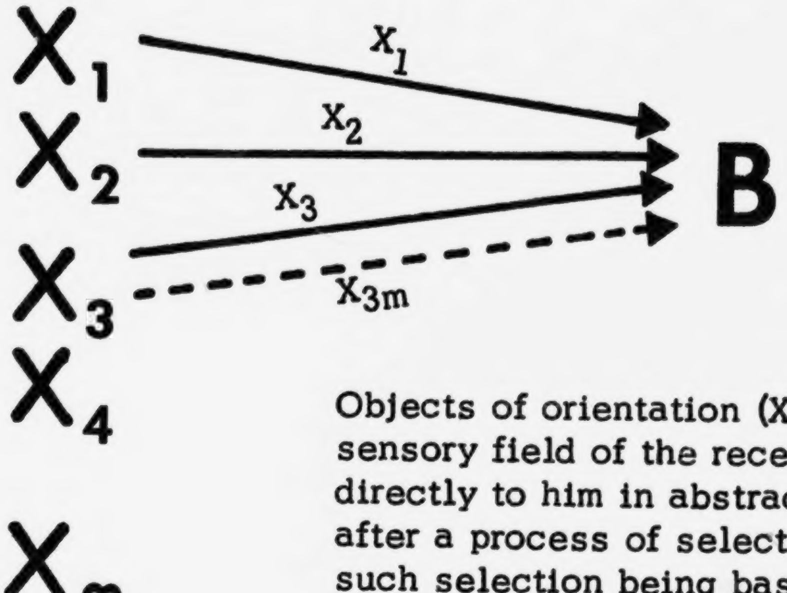
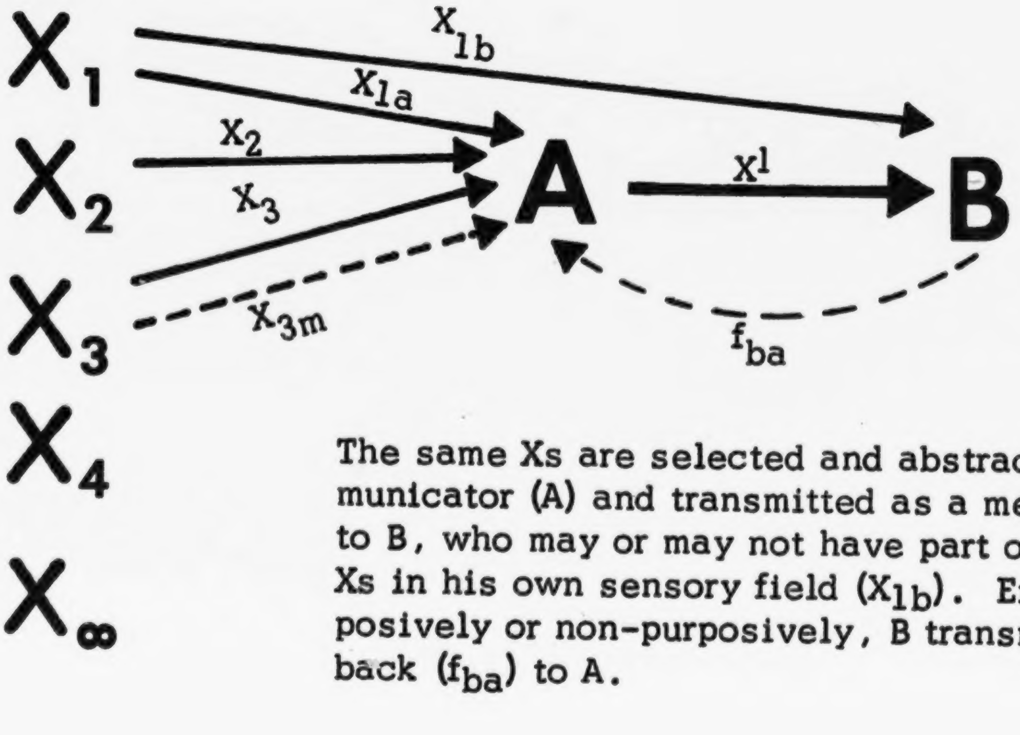

Observable communication stimuli
Predispositional factors
Internal mediating processes
Observable communication effects
Communication situation
Communication-free (General persuasibility)
Communication-bound
Content characteristics: Topic--content of the conclusions Appeals Arguments Stylistic features
Content-bound: Topic-bound Appeal-bound Argument-bound Style-bound
Communicator characteristics: Role Affiliations Intentions
Communicator-bound
Media characteristics: Direct vs. indirect interaction Sense modality
Media-bound
Situational surroundings: Social setting Extraneous noxious stimuli Extraneous pleasant stimuli
Situation-bound
Attention
Comprehension
Acceptance
Attitude change
Opinion change
Perception change
Affect change
Action change

Figure 5.--Psychological Model of Communication by Carl I. Hovland [7].

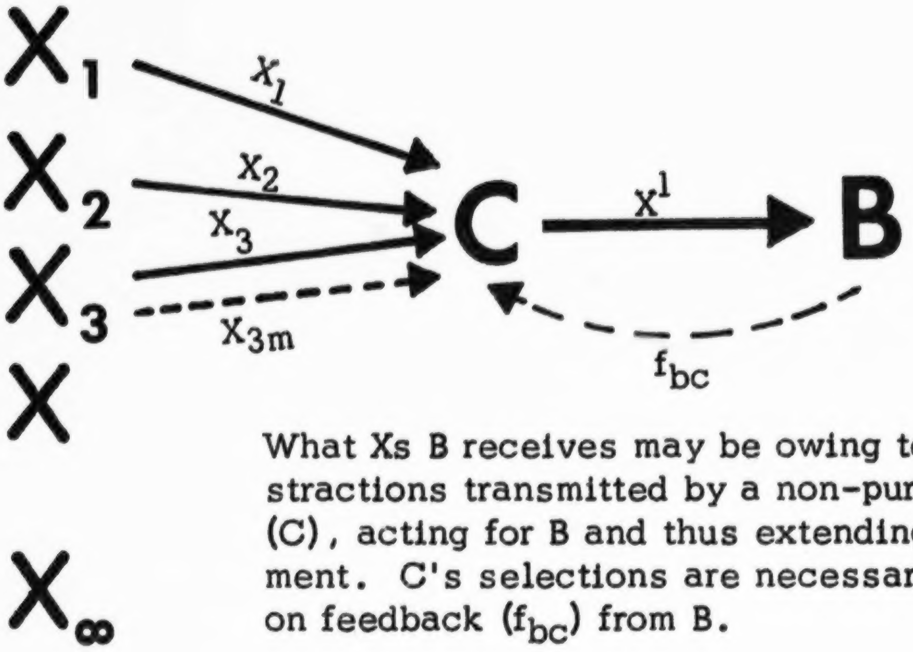

X_1
X_2
X_3
X_4
X_∞
x_1
x_2
x_3
x_{3m}
B

Objects of orientation ($X_1 \ldots X\infty$) in the sensory field of the receiver (B) are transmitted directly to him in abstracted form ($X_1 \ldots X_3$) after a process of selection from among all Xs, such selection being based at least in part on the needs and problems of B. Some or all are transmitted in more than one sense (X_{3m}, for example).

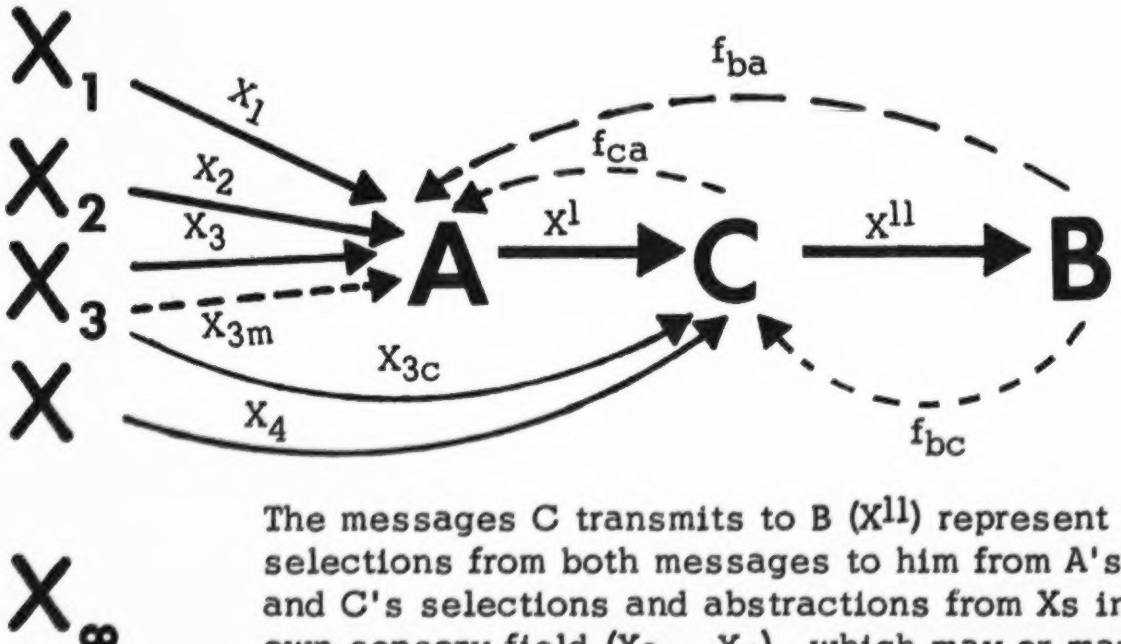

X_1
X_2
X_3
X_4
X_∞
x_{1b}
x_{1a}
x_2
x_3
x_{3m}
A
x^1
B
f_{ba}

The same Xs are selected and abstracted by communicator (A) and transmitted as a message (X^1) to B, who may or may not have part or all of the Xs in his own sensory field (X_{1b}). Either purposively or non-purposively, B transmits feedback (f_{ba}) to A.

(Continued)



What Xs B receives may be owing to selected abstractions transmitted by a non-purposive encoder (C), acting for B and thus extending B's environment. C's selections are necessarily based in part on feedback (f_{bc}) from B.



The messages C transmits to B (X^{11}) represent his selections from both messages to him from A's (X^{1}) and C's selections and abstractions from Xs in his own sensory field (X_{3C}, X_4), which may or may not be Xs in A's field. Feedback not only moves from B to A (f_{ba}) and from B to C (f_{bc}), but also from C to A (f_{ca}). Clearly, in the mass communication situation, a large number of Cs receive from a very large number of As and transmit to a vastly larger number of Bs, who simultaneously receive from other Cs.

Figure 6.--Perception-Source Model of Communication by Bruce S. Westley and Malcom S. MacLean, Jr. [8].

In education, it might be useful to regard the researcher or the professor as the "A" in the Westley-MacLean model schema. The high school teacher might most usually be the "C." The student, "B," is most likely to be at the "end of the line." I can certainly see some utility in conducting a descriptive study of the nature and the kinds of distortions present in this situation, or in trying to identify the presence of feedback in a typical situation of this kind.

We might again note that the new media are not mentioned. Presumably, they form a portion of the perceptual field of the receiver. However, although the model was prepared to stimulate research on the effects of the mass media, the media themselves receive no emphasis as separate or distinct elements of the process of human communication.

Sociological Model of Communication

A final model (Figure 7, following) is quite different from those which we have already considered. Riley and Riley are interested in the sociological, rather than in the perceptual or psychological, nature of human communication [9]. Figure 7 shows the social influences at work on any communicator (C) and on any receiver (R). The model thus places major emphasis on communication within a social setting. Again, the media of communication are not mentioned, although it is evident that they could be included as a part of the "Larger Social Structure" mentioned in the model. It is important to note that this visualization emphasizes the influence of reference groups and the influence of culture on the process of communication.

Communication Models: Summary

The seven models of the communication process discussed in this section are representative of many others which could have been introduced. They quite clearly indicate that specific consideration of the new media, and their use in either communication or education, has not occupied the time of many theorists. The visualizations also illustrate the variety of interests in human communication. One may also infer that, at present, there is no "major"

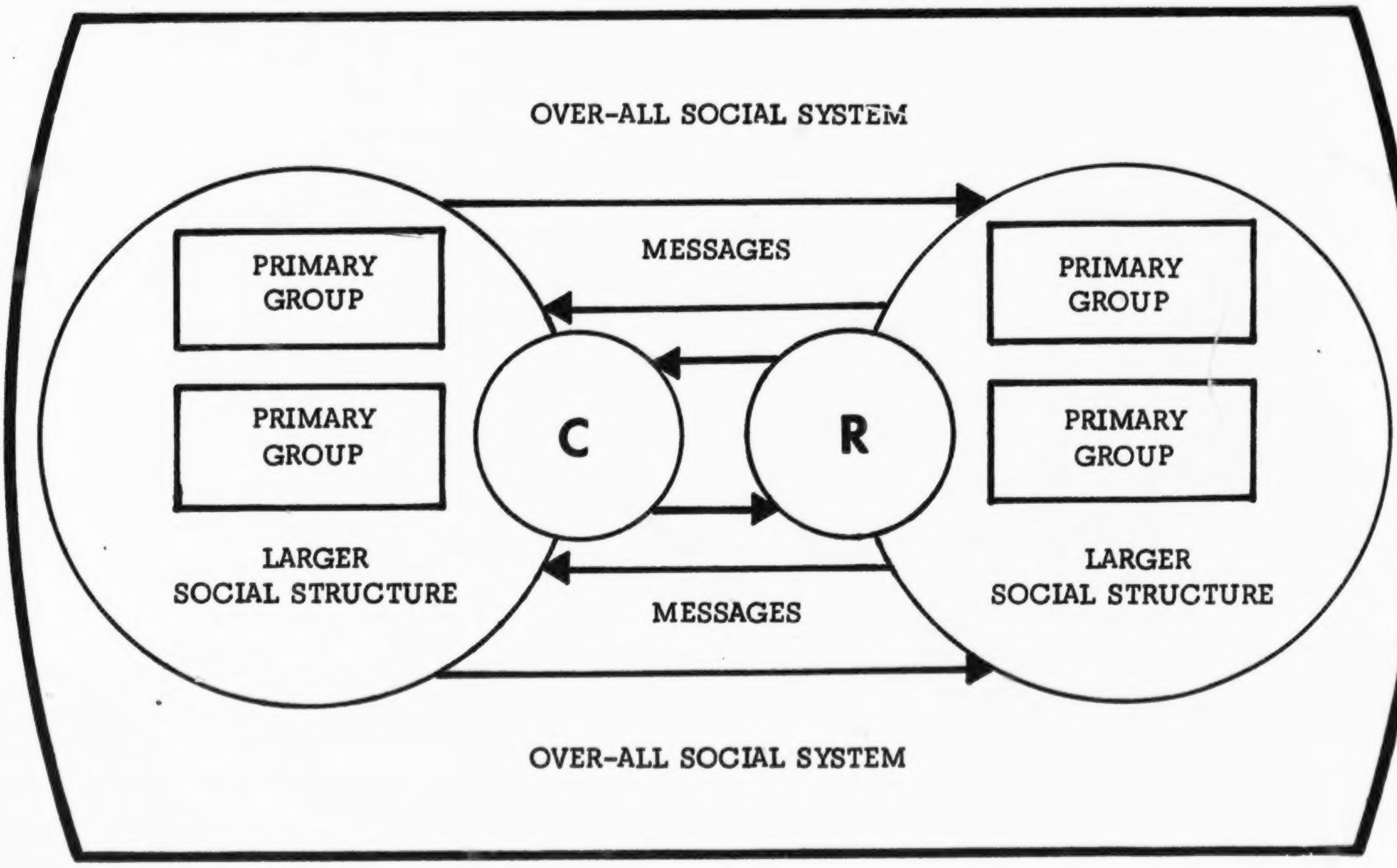

OVER-ALL SOCIAL SYSTEM
PRIMARY GROUP
PRIMARY GROUP
LARGER SOCIAL STRUCTURE
MESSAGES
C
R
MESSAGES
PRIMARY GROUP
PRIMARY GROUP
LARGER SOCIAL STRUCTURE
OVER-ALL SOCIAL SYSTEM

Figure 7.--A Sociological Model of Communication by John W. Riley and Matilda White Riley [9].

area of emphasis in communication theory. One theorist is primarily interested in the relationship of the source to the rest of the process. Another theorist concentrates on the perceptual process functioning within a communication framework. A third is interested in the social influences on the process, which operate within the process.

The seven graphic representations we have here also tend to reinforce the suggestion made at the beginning of this section: There is available to us--at present--no single, unified communication theory which will deal successfully with the role of the new media, or with the multitude of other variables present in communication situations. The study of communication draws heavily from psychology, sociology, rhetoric, linguistics, and from many other disciplines.

In summary, I would argue that the varying nature of communication problems makes for a richness in handling research questions. This variety--and richness--is not as fully available in other disciplines. It is undeniable, however, that this same situation makes it difficult to classify "communication theory" as neatly as "social theory" or "learning theory."

Balance Theory and the New Media

The previous sections of this paper suggest that communication theory is not limited to any one aspect of communication. There have been theorists who were primarily intersted in study of the message. Others have been interested in receiver variables. If we are interested in use of the new media in education, we can approach the subject fruitfully through a consideration of balance theory.

In this section, we shall be concerned with: (1) an explanation of balance theory, and (2) an analysis of the relationship of balance theory to use of the new media in communication and in education.

Basis of Balance Theory

Man tends to behave consistently. This proposition is basic to balance theory. We can elaborate this proposition to suggest that man tends to behave consistently with respect to his perceptions, memories, beliefs, past experiences, attitudes, and opinions.

Examples of such behavior are numerous. A woman who belongs to the WCTU is not likely to have a large stock of alcohol in her house. A man who believes that the world was created in 4004 B.C. is not likely to believe that man descended from apelike ancestors. The man who flunked out of college is likely to argue against the value of a college education. Within certain limits, we are surprised when an individual expresses opinions which are apparently contradictory.

The proposition, "Man tends to behave consistently," is not new. Study after study has indicated that, for any individual, sets of racial, religious, or political attitudes are usually internally consistent. We are constantly being surprised by behavior which appears to be inconsistent. The temperance worker arrested for drunken driving, or the policeman arrested for robbery, makes headlines because their actions violate our sense of what is right and wrong for such individuals. We are not nearly as surprised when a three-time loser robs a bank as when a trusted teller performs the same act.

Balance theories in the behavioral sciences are found under several different labels. Osgood and Tannenbaum refer to "congruity" [10], Heider to "cognitive balance" [11], and Festinger to "consonance" [12]. Closely related theories are those of Newcomb, who refers to a "strain toward symmetry" [13], and Stagner and others, who talk about "homeostasis" [14, 15]. Although all of these formulations are but specific applications of a more general theory, there are differences among them. Most of the applications to communication situations have come from Osgood and Tannenbaum, from Festinger, and from Newcomb. A brief discussion of each of these three positions will help us in understanding the phenomena better.

Newcomb: Strain Toward Symmetry

The simplest of the three theories is that of Newcomb (Figure 8, following). Newcomb suggests the presence of a strain toward symmetry in certain states of a simple communication situation in which individual A communicates with individual B about some object or concept X. The paradigm for this approach is given in Figure 8a.

Newcomb suggests that we can analyze the relationships among the three elements of Figure 8a, and then predict the kinds of behaviors in which the two individuals are likely to engage. In this situation, we can postulate that A holds some set of attitudes towards X. These attitudes may be characterized as favorable (+), or unfavorable (-). Similarly he holds attitudes towards B, and is aware of the attitudes that B holds towards X. Newcomb suggests that when these three sets of attitudes are all positive (Figure 8b) the situation is balanced. There will be no strain toward symmetry, because A's and B's orientation toward X are similar.

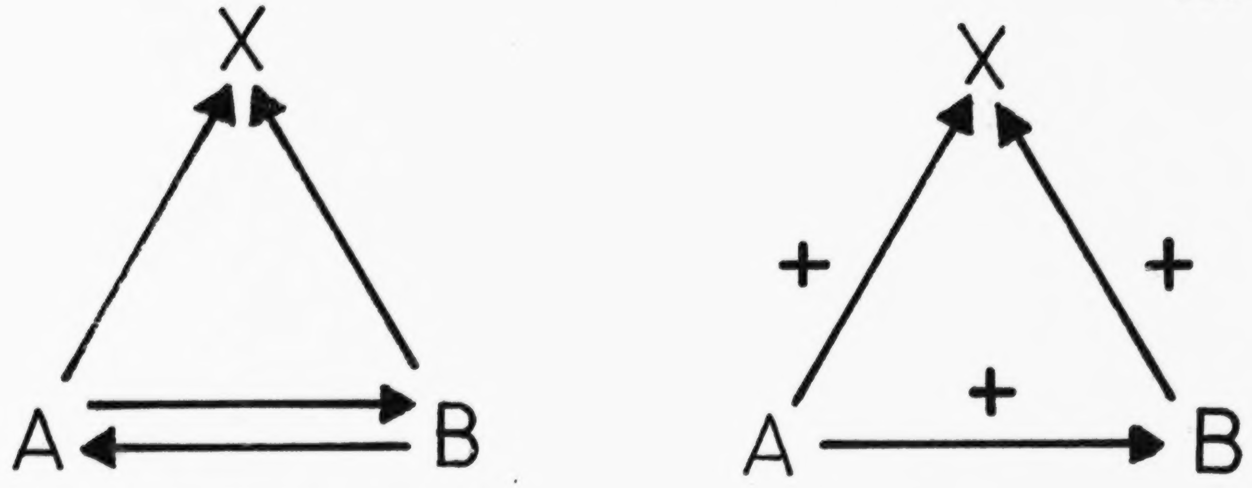
An unbalanced case is shown in Figure 8c. Here we can imagine that A is highly favorable toward "progressive" education. He also has a high opinion of Mr. B. But, in conversation, he discovers that B is antagonistic towards progressive education. This is an unbalanced situation, and Newcomb proposes that there will be a strain toward symmetry. Under these conditions, A will perform in such a way as to rebalance the configuration.

What might A do in the situation of Figure 8c? We can suggest that there are at least five kinds of behavior which tend to achieve the goal of a balanced configuration:

1. Individual A can engage B in persuasive communication designed to change B's attitude toward X, that is, make it favorable.

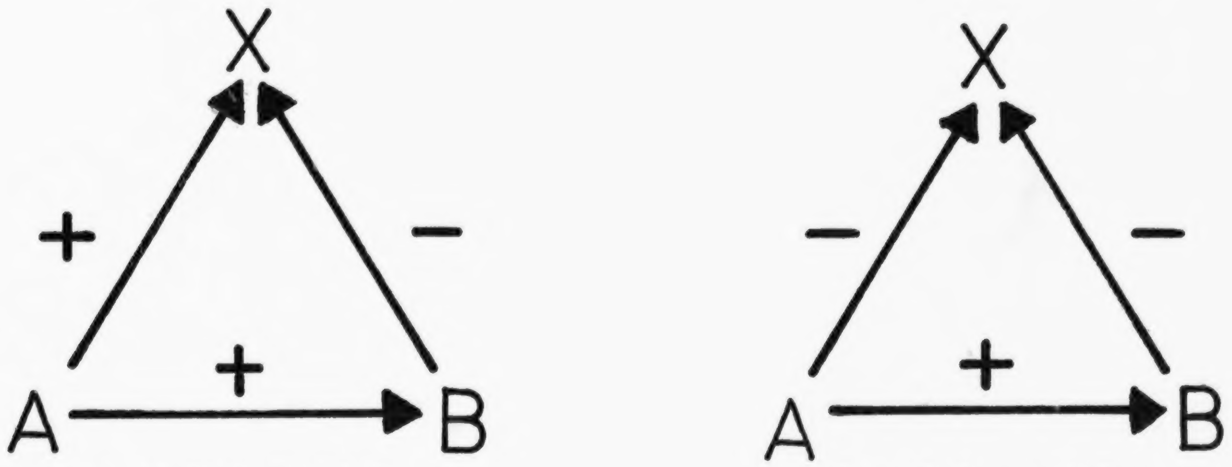
2. Individual A can change his own attitude toward X. The situation is balanced if both A and B are negative toward X--as shown in Figure 8d.

3. Individual A can misperceive B's attitude towards X. He may (can) assume that he must have misread B, and that



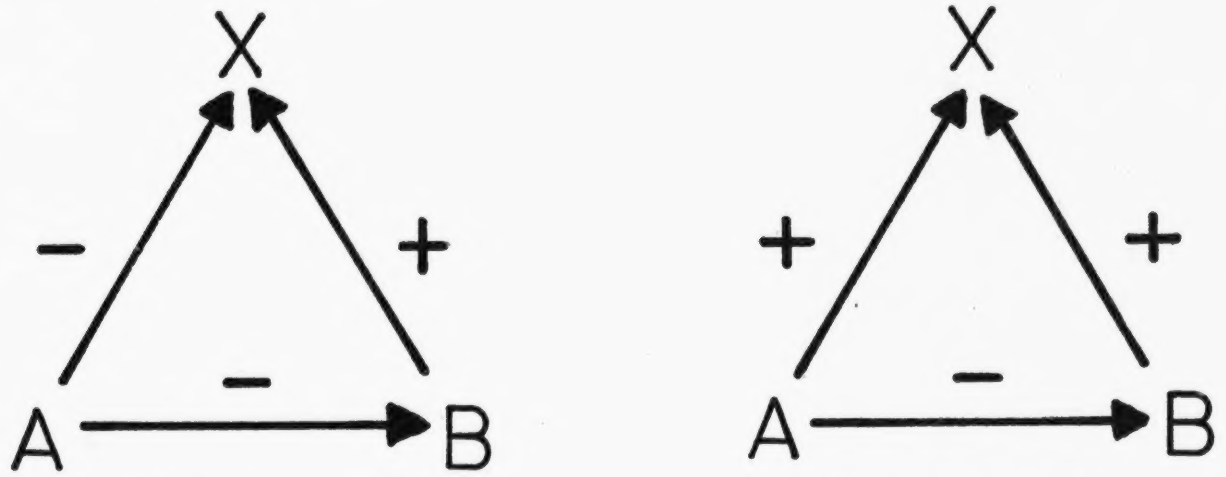
8a: Newcomb's Theory

8b: Balanced State



8c: Unbalanced State

8d: Balanced State



8e: Unbalanced State

8f: Balanced State

Figure 8.--Strain-Toward-Symmetry Theory of Communication Acts by Theodore Newcomb [2].

such a fine fellow obviously cannot be really negative toward X.

4. Individual A can stop talking to B about X. Most of us have friends with whom we get along very well--as long as we don't mention certain subjects.

5. Individual A can dissociate himself from B. This step is a drastic one. However, many of us know people with whom we were once friendly and no longer see--perhaps because of disagreements about someone or something.

In Figure 8, paradigms 8b, 8d, and 8f represent balanced states, while 8c and 8e are unbalanced systems.

In the foregoing discussion, we have not considered the behavior to be expected when the entire model, presented in 8a, is considered. That is, we have not looked at B's relationship to A and at A's attitude toward X. Here we might expect the same sorts of behaviors to occur. However, these behaviors may be complicated by the chances of mutual attitude change or mutual dissociation.

In developing his theory, Newcomb suggests that the stronger the imbalance, the stronger will be the forces operating to reduce the imbalance. This corollary to the basic proposition is similar to those found in all other cognitive balance theories. Newcomb, however, does not suggest tests for the intensity hypothesis, since he does not postulate measurement units for intensity.

Osgood and Tannenbaum: Congruity

Osgood and Tannenbaum call the balance concept "congruity." In the one context, they are interested in the reactions of a communication receiver to a situation in which a source makes an evaluative statement about an object or a concept. They study the phenomena in the case in which a receiver is exposed to a perceptual field made up of two signs related by an assertion. In the communication situation, one sign can be identified by the receiver as a message source. For example, President Kennedy, Louella

Parsons, *New York Times*, *United Nations*. The other sign is a concept, such as *progressive education*, *free love*, *Africa*. The two signs are related by an assertion, which may be either positive (associative) or negative (dissociative). An example of the total perceptual field might thus be a receiver seeing the headline "President Kennedy (the source) Favors (the assertion) Independence for Laos" (the concept).

If an individual were attitudinally favorable toward both *President Kennedy* and *Independence for Laos* before seeing the headline, no incongruity or imbalance will exist after seeing the headline. We would not predict attitude changes toward either source or concept in the Osgood Tannenbaum paradigm. But if the individual held a favorable attitude toward *President Kennedy*, and also held a negative attitude toward *Independence for Laos*, Osgood and Tannenbaum suggest that incongruity does exist, and that changes in attitude are likely to occur. The individual could *lower* his attitude toward *Kennedy*, that is, make it less favorable; or he could *raise* his attitude toward *Independence for Laos*, that is, make it less negative (or more positive); or both raise and lower his attitude toward the attitude objects.

Osgood and Tannenbaum state the general congruity principle as follows:

> Whenever two signs are related by an assertion, the mediating reaction characteristic of each shifts toward congruence with that of the other, the magnitude of the shift being inversely proportional to intensities of the interacting reactions [16].

They are also able to specify the location of congruence for any situation:

> Whenever two signs are related by an assertion, they are congruent to the extent that their mediating reactions are equally intense, either in the same (compatible) direction of excitation in the case of associative assertions or in opposite (reciprocally antagonistic) directions in the case of dissociative assertions [17].

In addition, Osgood and Tannenbaum are able to state a principle for the repeated association of two signs with an assertion, a congruity learning principle which has not yet received experimental support. Although we are interested here in the perception of a source and a concept, the congruity principle has also been tested in the perception of a word combination involving a noun and an adjective such as lazy student.

The congruity principle is unique among balance theories in that it suggests that the evaluations placed on both the source sign and the concept sign will change if imbalance exists, and that each will change to a specified extent dependent upon the change in the other sign. In terms of the new media, the congruity hypothesis, as it has been formulated and discussed by Osgood and his associates, cannot directly account for changes due to differences in the communication channel employed. However, research by the author on speakers in a persuasive speaking situation suggested an extension of the basic model to situations in which more than two signs are used. The results also suggested that the basic model may be useful in any situation in which perceptual objects are placed within a single field, and evaluations are later made of the influence of one object on another as a result of perceived incongruity [18].

We may suggest here that the congruity situation, as emplyed by Osgood and Tannenbaum and by the author, lends itself well to a consideration of certain problems in education. Let us consider the situation in which a teacher (the source) is using a blackboard to illustrate a lesson on the binomial theorem (the concept). From one student's point of view, there may be nothing worse than the binomial theorem. He may like the teacher on first contact, but it is doubtful that his initially favorable attitude toward the teacher will continue under all conditions. Furthermore, we might point out that balance theory would suggest that the media used by the teacher, i.e., the blackboard, may well become tarred with the same attitudinal brush. On the other hand, if the teacher is extremely well liked and the subject only mildly disliked, it might well be that the student will eventually become more favorable in his attitude toward the subject.

There is nothing in the congruity principle to suggest that a favorable impression of television gained from watching Captain Kangaroo as a child will not carry over to increase a student's interest in, and favorable attitude toward, Newton's Second Law when he sees it presented over educational television. On the other hand, there is also nothing in the congruity principle to suggest that an initially unfavorable attitude toward "science," gained by the child from early attempts at forcing him to become interested in the wonders of nature, will not influence unfavorably the student's later attitudes toward the television medium which carries a film on dissecting a frog. The congruity principle would be able to make a prediction in either case, but the accuracy of the prediction would depend upon the intensity of initial attitudes toward the elements of the situation.

Festinger: Cognitive Dissonance

Festinger's book, A Theory of Cognitive Dissonance, offers perhaps the most general formulation of the three balance theories discussed in this paper. For Festinger, the units of study are "the relations which may exist between pairs of elements." Festinger uses "elements" to refer to cognitions, knowledges, opinions, attitudes, beliefs, and values. He suggests that three kinds of relations may exist between pairs of elements. If, for an individual, two elements have nothing to do with one another cognitively, we say that they are irrelevant to one another. If two elements exist in a relevant relation to one another and if each of the elements follows from the other, then a state of consonance exists. Finally, if two elements exist in a relevant state with one another and the obverse of one follows from the other, then the elements are in a dissonant state.

Dissonance theory, like the theories of both Newcomb and Osgood, postulates the existence of forces to reduce dissonance:

> . . . The presence of dissonance gives rise to pressures to reduce or eliminate the dissonance. The strength of the pressures to reduce the dissonance is a function of the magnitude of the dissonance [19].

Festinger's theory is considerably broader than either Osgood and Tannenbaum's or Newcomb's in that all possible kinds of percepts and concepts were considered in its development, and it suggests that any combination of overt behavioral changes and cognitive changes may be involved in the attempt to reduce dissonance. The theory is not limited to communication situations. In his work, Festinger has presented data from a wide range of contexts which he considers relevant to the theory of dissonance. The data include those from some typical communication situations.

Festinger does not confine himself to any one set of experimental techniques the way that Osgood and Tannenbaum tend to use semantic differential measuring devices. The theory does have limitations, however. For example, it is constructed in such a way that, in practice, almost any reaction on the part of an individual may be construed as confirmation of the theory. This characteristic makes it difficult to disprove the tenets of the theory. However, it also makes it difficult to offer rigorous support for the theory, or to develop a measurement model which "fits" the propositions underlying the theory.

Balance Theories: Common Elements

The three theories which we have discussed in detail are perhaps those which are most applicable to education and to communication. It should be noted, however, that other balance theories do exist and agree in all relevant aspects with those discussed here. If we were to synthesize the theories, we might arrive at the following conclusions:

1. All cognitive balance theories assume that the individual places values on the objects and signs which he perceives.

2. All balance theories postulate that when two or more objects are placed within the same cognitive or perceptual field, the field may be described in terms of the values which the individual originally placed on the objects within the field.

3. All balance theories hypothesize that when the values held for objects within the same perceptual or cognitive field are internally consistent, a state of balance exists, and the individual will do nothing to change the values he holds toward the objects.

4. All balance theories assume that when the values placed on objects within the perceptual or cognitive field are not consistent for the individual, a state of imbalance exists, and an individual will take steps to restore balance to the perceptual or cognitive field.

5. All balance theories hypothesize that the strength of the pressures to reduce imbalance are a direct function of the magnitude of the imbalance.

Other similarities among the various theories could be suggested, but the five mentioned above seem to be basic to all theories of cognitive balance.

Balance Theories: Applications and Extensions

At this point, let us assume that sufficient evidence has been collected to enable us to accept the validity of the five propositions above, and go on to suggest some additional implications of balance theory. What we are concerned with here are the ways in which a communication receiver's perceptions of the new media "fit with" his perceptions of the rest of the elements which are present in any communication situation.

If an individual were to perceive an object for the first time, and if that object were totally strange to the individual, we would expect him to assess or otherwise obtain meaning for what he sees. He may attempt to relate the behavior of the object to similar behaviors observed in other situations. He may try to find out what linguistic symbols other individuals use to label the object. This process is the rather familiar one of acquiring an objective, denotative meaning for a sign or an object. But at the same time that the individual is attempting to acquire a set of denotative meanings for the object, he is also engaged inevitably in the process of acquiring a set of evaluations about the object. In relating the object to other objects met in the past, he will make decisions regarding the values which can be placed on the object. He may characterize the object as good, fair, pleasant, useful, or beautiful. Or he might decide that the object is worthless, ugly, harmful, and dangerous. This process of evaluation is at least part of what we mean by the process of acquiring a set of connotative meanings.

Balance theory makes the assumption that, when an individual acquires a set of evaluations about an object or about a set of objects, these evaluations will be consistent with evaluations of other objects with which the new object is associated. As an application, we can imagine a student who has developed a cordial dislike of all teachers and all subject matter. He is only waiting until he reaches the age of sixteen to drop out of school. Suddenly, one of the teachers introduces a teaching machine to improve the presentation of American history. Balance theory would predict that the attitude developed toward the teaching machine will be like the attitude held by the student toward the other objects in the immediate environment, i.e., the teacher and the subject. We certainly are not justified in predicting the development of anything other than a negative attitude toward teaching machines. Definitive research needs to be done on this hypothesis, but preliminary work being done at the University of Michigan seems to support this observation.

Although there is no necessity for it, balance theories have tended to be restricted--in practice--to the prediction of changes in an individual's attitudinal structure as it is indexed by standard instruments. Attitudes are usually measured after the individual has had time to form a relatively complicated set of attitudes toward a given attitudinal object. Again, in practice, the experiment offered as support for the theory typically measures attitude change toward two or more attitude objects--after the subject has been exposed to a combination of the objects for a relatively short period of time.

For example, in a study by the author, subjects were asked to make attitudinal judgments about speakers in a persuasive speaking situation. The speakers were perceived as being linked with the message they were delivering for approximately five minutes. Post-speech measures toward both speakers and speech topics showed that considerable attitude change had taken place. Most of the change was toward the speakers, and could be predicted largely in terms of the subject's impression of the speaker's delivery and the speech topic. The theory was supported, but one wonders what would have happened if, in a nonvoluntary situation, the subjects had been exposed to the same speaker every day for a nine-month period. I would suggest that attitudes in this situation would become fairly well fixed, and that relatively wide--but momentary--deviations in behavior might be tolerated before extensive attitude change could be expected to take place.

Osgood and Tannenbaum postulate a congruity learning principle to handle the case of repeated association of two objects or two signs. They suggest that each time two objects or signs are related, attitudes held toward the two signs will be expected to shift more and more toward congruence. This observation certainly makes intuitive sense, but it remains to be tested in a practical situation. An educational situation in which teachers, toward whom differing attitudes are held, present materials, toward which differing attitudes are also held, would be an ideal situation for testing the hypothesis which relates congruity and learning.

A final application of balance theory arises from some research results on the idea that individual differences, noted in some research projects, seem to indicate the existence of a personality trait which might be labeled as "tolerance for incongruity," or "tolerance for dissonance." When some individuals are presented with an attitudinally incongruous situation, later testing shows that they have indeed changed their attitudes to represent a more consistent position. Other individuals holding equally intense attitudes seem to have much greater tolerance for such situations, and no attitude change is noted.

At least three explanations can be offered for this phenomenon: (1) measuring instruments are too gross to detect changes which may have actually occurred; (2) the attitudes are in the process of being reorganized and the particular test was not designed to show the process of attitudinal reorganization; or (3) individuals do indeed differ in their tolerance for incongruous situations.

Work by Rokeach [20] seems to indicate at least some differences between individuals in terms of how much uncertainty they will tolerate. The studies in this area are quite preliminary, but for education, quite important. It is entirely possible that, if this type of tolerance is a relatively basic trait for individuals, it may help to predict success in college, ability to absorb new materials, or potential career goals. More work is certainly needed in this area.

We have seen that balance theory is particularly applicable to communication situations, and have suggested that it might well be applicable to education situations as well. We are now ready to return to our consideration of a number of visualizations of the communication process, and ask which elements are important to research linking education and communication with balance theory. Almost all models made reference to the functions of source, message, channel and receiver. Under these categories, at least some areas of research needed to link the study of education with the study of communication can be suggested:

1. Communication Sources. If the new media of education are to be used, they must become identified with a source or with a series of sources in the minds of receivers. Connotative meanings developed about sources might include evaluations of his perceived subject matter competence, teaching ability, speaking ability and general credibility. These categories are obviously not exclusive and research might well be able to refine them somewhat.

2. Messages. Relatively little research has been done on differential characteristics of messages which might make a difference in the kinds of attitudes to be expected. We might suggest that the structure or style of the message, the kinds of evidence and the types of appeals used, the presence or absence of particular codes, and the use of visuals are a few areas where information might help in predicting changes in connotative meanings.

3. Communication Channels. There are many questions involving the choice of one or another of the new media for presentation of a particular message. We might ask: What attitudes have already been formed toward the channel? What kinds of messages seem best for what channels? Do certain sources use certain media better than other media?

4. Communication Receivers. We are well aware that there are individual differences in receivers of communication.

These differences should affect the ways in which messages are received, the ways in which sources are perceived, and the effect that a particular choice of channel will have. Research here would attempt to develop typologies of individuals with respect to tolerance for dissonance, general methods of resolving imbalance, and perceptual differences in the ways in which communication stimuli are viewed.

Conclusion

This paper has suggested that "communication theories," as such scarcely exist. An interest in communication situations and problems has occupied the interest of a number of individuals. The theories which have been applied to communication situations by individuals interested in communication phenomena have been drawn from many different areas. Some indication of the varied nature of interest in communication phenomena can be gained by looking at a number of heuristic visualizations of the process of communication as it is perceived by different individuals.

If it is true that there is no single "communication theory" which we can examine, it is entirely possible to look at other theories about human behavior and examine their applicability to communication and then to education. In this paper, the general notion of cognitive balance is examined, and suggestions made for possible research applying the principles to an educational situation.

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17. *Ibid*.

18. Erwin P. Bettinghaus, "The Operation of Congruity in an Oral Communication Situation," *Speech Monographs*, XXVIII (August, 1961), 131-142.

19. Festinger, *op. cit.*

20. Milton Rokeach, *The Open and Closed Mind*. New York: Basic Books, Inc., 1961.

ADDITIONAL REFERENCES

The working paper annotates the basic positions of Osgood, Newcomb, and Festinger. The items which follow are not discussed in the paper, but are considered to give important insights into the basic ideas of balance theory.

Dorwin Cartwright and Frank Harary, "Structural Balance: A Generalization of Heider's Theory," *Psychological Review*, LXIII (September, 1956), 277-293.

The authors attempt to construct a formal definition of balance in terms of the mathematical theory of linear graphs. In general, they follow the Heider constructs, but their formulations have more generalizability.

Carl I. Hovland and Milton J. Rosenberg, *Attitude Organization and Change: An Analysis of Consistency Among Attitude Components*. New Haven, Connecticut: Yale University Press, 1960.

This book reports a series of studies in an area which Hovland and his associates choose to call, "consistency." In general, "consistency" does not differ from other balance theories. However, it appears to derive more specifically from the older Hovland model for attitude change. Several of the experiments reported are elaborations of studies reported elsewhere. This series of attitude change experiments seem to conform to a balance theory model.

Charles E. Osgood, "Cognitive Dynamics in the Conduct of Human Affairs," *Public Opinion Quarterly*, XXIV (Summer, 1960), 341-365.

This article is one of the few attempts at constructive criticism of positions taken by various balance theories. The author suggests practical applications, and attempts to indicate the extent to which behavioral phenomena seem to conform to the concepts of balance theory.

R. Stagner, "Homeostasis as a Unifying Concept in Personality Theory," *Psychological Review*, LVIII (January, 1961), 5-18.

Homeostasis is the biological concept most analogous to the psychological construct of cognitive balance. In general form, it states that all behavior is an attempt to preserve integrity by successive restorations of equilibrium. In his article, Stagner tries to generalize the biological construct to certain personality constructs.

Social Theory and the New Media

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Basic Perspectives

Introduction

In order to analyze the impact--actual and potential--of the new media, a twofold approach is proposed. First, the new media must be seen not only as technological capacities but also as organizational systems which require analysis in terms of their social arrangements. The new media are becoming social institutions with authority relations, division of labor, and internal communication processes which condition their mode of performance. Second, the new media must be seen in terms of the social environment in which they operate. We are dealing with an ongoing social process of interaction between the media as organizational systems and the audience as participators in various social groups.

Three models are available for the proposed analysis. Each of these models involves a value orientation as well as a typology of analysis.

The "Mass Society" Model

From a value point of view, it is assumed that the performance of the new media has been deficient and justifies severe criticism. In this model, the mass media represents one aspect of the technological base of modern society. Modern society has a complex division of labor which produces segmental social relations, standardized human behavior, and strong pressure towards depersonalized social relations. But the mass media are essential for the coordination of modern society. By their inherent nature, the mass media contribute towards greater standardization and greater depersonalization of human affairs. When the mass media are organized for profit, or for personal privilege, their disruptive consequences are accelerated. From this point of view, the impact of the mass media is powerful and pervasive. More often than not, they operate to weaken the social fabric of society and thereby contribute to extremist political movements.

The mass media can have an integrative role only by self-restraint and self-regulation, but there is doubt about the power of these forces. The "Mass Society" model includes, as crucial elements, active intervention by the government and by private associations.

The "Behavioral Science" Model

The value assumptions of this model are less critical of the current level of performance of the mass media. There is no emphasis on the essential standardization and depreciation of the content of the mass media. To the contrary, it is assumed that, with the growth of education, larger and larger portions of society have been drawn into the effective fabric of society by their involvement in the mass media.

The complex division of labor caused by technology is one aspect of modern society. But the "Behavioral Science" model emphasizes the web of interpersonal relations, and the persistence of social values, which make modern society possible. For these reasons, the mass media are seen as having a rather limited impact. Moreover, their impact is gradual, and long-term, and mainly effective when the content of the mass media articulates with interpersonal processes, with primary group relations, and with the structure of opinion leadership. This model is aware of the vulnerabilities of modern society to mass agitation, but it interprets the findings of contemporary empirical research as buttressing its view of the limited potentials of the mass media. This model emphasizes self-regulation and professional standards as requirements for using the mass media effectively.

The "Functional Analysis" Model

This is the model which I shall employ in this paper. It is a modification of the "Behavioral Science" model. Its value assumptions are not either that the mass media have performed relatively effectively, nor that they should be sharply criticized. The basic value assumption is more hypothetical: How can the mass media be organized so as to optimize certain essential values--particularly the development of human dignity and of personal self-esteem? My approach accepts much of the "Behavioral Science" model, namely, that modern society is rooted not only in a complex division of labor but also in interpersonal relations, values, and norms which limit the immediate impact of the mass media. This model assumes, however, that the impact of the mass media is maximized under the following conditions: (a) periods of stress, crisis, and rapid social change, and (b) the content of the mass media becomes so uniform that, over long periods of time, it is able to alter the "definition of the situation" and the meaning of social and political alternatives.

My approach also focuses heavily on the interaction between the internal structure of mass media systems and the social environment of the audience. Therefore, the approach seeks to isolate those variables which deal with the internal control and management of the mass media and which can reorient and modify the practices of mass media systems--new and old.

For our purposes we can think of the mass media as having three functions: the socializing function, the information function, and the mobilization function. By the socialization function, I mean the transmission of a cultural system, and the inculcation of values and norms which make possible a person's participation in a variety of social groupings--from the family to the nation state. By the information function, I mean the transmission and dissemination of information and essential knowledge; and the posing of economic, social, and political alternatives as well. By the mobilization function, I mean the processes of persuasion, and the development of loyalties and attachments which are essential for collective problem solving. These functions are at work both in a free society and in a totalitarian society. But they are more crucial in a free society than in a totalitarian society which relies predominately on terror as a technique of social control.

In this paper, I am interested in examining the convergence of the new mass media and the mass educational system. In the United States, despite decentralized administration, our education system has an important element of unity because it has been a comprehensive system. While there is a separation between terminal secondary education and preparation for higher education, this separation has been minimized and has been operated so as to make possible actual shifting from one level to the other. We are, however, on the threshold of a great revolution in education, a revolution which might be called, "The Organizational Revolution in Education." At the higher end, one-third to one-half of our population is likely to receive some education beyond secondary school; at the lower end significant proportions will "drop out" of secondary education. Under these conditions, old concepts of a comprehensive educational system seem to be more obscuring than clarifying.

The task of the functional analysis of the new mass media is to contribute to an understanding of the changes which are underway in the system of mass education. Unless we are able to manage this emerging system of education effectively, the impact of the new media may well produce a more rigid two-stream or two-track system of education. The emerging two-track mass education is not a system based on the difference between the college track and the non-college track. The issue is more complex.

The first track, I call the custodial track. In this track, which includes all levels of education--primary school to higher education--the educational format treats the student body in each specific type of institution on a uniform and mass basis. Emphasis is placed on specific skills--technological and even social adjustment skills. The role of the new media in this track will be to help achieve and to maintain a uniformity of treatment of broad categories of students.

The second track, I will call the problem solving track. In this track, the emphasis will be on differentiated treatment of the student body with a view to developing both the technical skill and the personal self-esteem of students. In this track, the new mass media will have the task of making possible differentiated educational experiences. The concepts of the problem solving track apply to all levels and to all types of mass educational institutions, including especially the terminal high school.

Advanced Industrialism: The Social Environment

What are the major features of American society which set the context in which the new media operate? Under advanced industrialism, there is continuous technological development which alters the social structure. "Urbanism as a way of life" becomes the central organizing principle when the bulk of the population concentrates in large metropolitan centers. The class stratification system can no longer be described as a pyramid, since more of the population is in the middle stratum. The line between the bottom of the upper class and the middle class becomes blurred. The great middle majority outnumbers those at the bottom of the social structure.

The social problems of the middle class derive from affluence, from mobility, and from the clash of values. (There is no evidence of a decrease in opportunity for upward mobility under advanced industrialism; likewise, disruptive downward mobility persists.) Such mobility--social and geographical--places great strain on primary interpersonal relations. The processes of rapid social change increase the gap in intergenerational values and create problems of youth and adolescence.

At the bottom of the social structure, poverty becomes chronic because of sickness, broken families, and mental illness. These dispossessed groups are not likely to benefit by the rising standards of living. In the middle class, voluntary association becomes an essential aspect of social life. In general, the class conflict weakens, and competition between the skill and professional groups intensifies.

But perhaps the most profound transformation is the transformation in expectation--the revolution of "rising expectations." The population insists on higher standards of living. Minority groups demand social justice as a part of the process of achieving what I call the "Great Society." The mass media are central in developing these personal expectations. Society seems more and more prepared to acknowledge the justice of these demands, particularly of the elimination of social and ethnic discrimination. Repression gives way to the demand for consensus and mutual toleration.

Aside from juvenile delinquency, there is no evidence that crime, mental illness, and deviant behavior have increased. But at the threshold of affluence and the "Great Society," public opinion demands that these ills be eliminated or greatly reduced. Slums and slum schools, which have always existed in urban industrial centers and which probably have become more of a social problem, enter into the consciousness of society in a dramatic way. In a sense, modern social structure is beset by a deep paradox. The spread of affluence does not decrease social problems, it increases the demand to eliminate the existing social problems.

At the same time, the modern industrial revolution has been accompanied by a revolution in international affairs. The overwhelming destructive capacity of thermonuclear weapons means that international affairs penetrate more and more into the consciousness of the mass population on a day-to-day basis.

For each of the essential functions of the mass media--socialization, information, and mobilization--modern society requires of the mass media a greater emphasis on unifying and inclusive symbolism and content. The needs and demands of the mass audience must be articulated with the largest social units of society and, in fact, of mankind as a whole. The mass media must emphasize what is common among men. On the other hand, the diversity of social background, of personal capacity, and the complexity of specific tasks in modern society require the mass media simultaneously to adapt to a more and more heterogeneous audience. If mass education is to be problem solving rather than custodial, if it is to articulate with the social process of a free society, it must develop a new equilibrium in internal structure and in content to meet both of these fundamental needs.

Mass Communications as a Social Process

The functional model for the analysis of the new media is a social process model. It should be contrasted with the stimulus-response approach. The stimulus-response approach assumes that the stimulus is given or fixed, and seeks to understand specific responses. This approach underlies the experimental design of most of the studies of the mass media. It gives the impression of scientific precision. This approach underlies also a great deal of the use of information theory. While there are important engineering applications for the stimulus-response model, its limitations must be kept in mind, otherwise its findings may be applied out of context.

Criticisms of the stimulus-response approach are as classic as the formulation itself. The stimulus-response model does not concern itself with the genesis of the stimulus. It assumes a sharp distinction between stimulus and response. In reality, we are dealing with an interactive process in which the last response influences the next stimulus. The stimulus-response model assumes a one-way influence pattern when influence is at least two-way, although hardly balanced. More fundamentally, the stimulus-response model is not broad enough to encompass the realities of the organization of the new media, nor the social environment in which they operate.

The natural history of research on the effects of television during the last decade is an important case in point. In this area, the stimulus-response model fixed on the information function, and thereby had the consequence of underemphasizing the role of television as a process of socialization. The large number of studies on television indicate that, as a medium for disseminating certain types of information, television as compared with the classroom teacher, does not have inherent limitations.

These studies seem to shift the policy issue to one of economics. Is television cheaper than classroom teaching? Under some circumstances, it is cheaper. However, there is no reason to assume that television under all circumstances is more economical than the classroom teacher. Nevertheless, the studies of educational television have been resisted as a basis for planning because of the omission of the socialization function, namely, the impact on student interest, on student morale, on student values, and on student social organization. The stimulus-response type of study of television, by its very nature, has been concerned with very short-term consequences. There has been no effort to study mid-term--let alone long-term--consequences since this aspect would lie outside the experimental format. Rarely, if ever, is the crucial question asked: What is the impact of television instruction upon the teaching staff and upon the whole organizational capacity of the educational institution? In short: What are the side effects--when the side effects may be more powerful than the direct effects?

In contrast to the narrow, experimental approach, both theoretical issues and information crucial for policy making concerning the consequences of educational television, were produced as a result of a completely different set of research designs. These research designs were broad efforts at probing the socializing effects of mass television on children. While the research designs dealing with these problems have not completely freed themselves from the stimulus-response model, they do approximate the requirements for understanding the new media as a social process. Firstly, these studies were concerned not with specific programs, but with television content. Secondly, the emphasis was placed upon mid-term trends by use of survey techniques, especially by the comparison of different age groups. Thirdly, there was a strong emphasis on probing unconscious reactions and imagery. This probing was undertaken in order to study the modification of underlying values. It has even involved ingeneous work on fantasy in response to the aggressive symbolism of television. Fourthly, by studying how young people use television, the dynamics of youth sub-culture were brought into focus. This work on television makes possible a broad functional analysis.

There is ample evidence, as indicated by the mass society model, that television has an impact on socializing young people. There is ample evidence that television inhibited personal development and self-esteem. However, the mass society model is not applicable because all members of the audience are not uniformly affected. It is necessary to identify those portions of the audience which were strongly influenced by television as a social process. The portion of the audience who were strongly influenced is small. However, it is now no longer possible to speak of or to do reasearch on the informational aspects of the new media without bearing in mind its associated socializing effects.

Technology and the Social Requirement of the New Media

Is there not reason to believe that the impact of the new media is most likely to push mass education in the "custodial" direction by forcing greater standardization of content? Is there not reason to believe that the "mass society" model, which emphasizes depersonalization of human relations, is correct for the new media? Is there not reason to believe that the new media will weaken the authority and the competence of the classroom teacher by eliminating his discretion to influence the curriculum? Is there not reason to believe that the actual effectiveness of teaching will decline as the possibility of engaging in direct interaction with the student becomes more limited?

If one looks at the technological potentials of the new media, the main trend appears to be larger audiences exposed to specific messages--with less potential for feedback from the audience. The countertrends, which the mass media specialists emphasize, are the flexibility of the new media and the increased opportunity to use outstanding resources--both physical and professional.

But the consequences of the impact of the new media on the social process cannot be inferred directly from their technological characteristics. The basic issue is the social arrangements under which the technology is organized and utilized. It is the burden of my argument that only by examining the new media as a social process will we understand the potentialities of new media for strengthening problem solving education. This "position" involves analysis of authority patterns, of division of labor, and of internal communication. The consequences differ as we deal with the information, or the socialization, or the mobilization functions of the new media.

The recent developments in the printed media of education--the mass textbooks--are an interesting case in point. From a technological point of view, new printing processes make possible greater standardization of textbook content. Through more production of standardized materials, unit costs are reduced. As the cost of education increases, the pressure to reduce expenses through standardization should increase.

In recent years, there has been an anticipation of more standardization of content in textbooks. But, in actuality, the standardization of textbooks has contracted. There is now a greater variety of content. There has been an increase in use of classical and original materials. There has been an expansion in the use of specialized research and monographic material in teaching. There has even been an increase in the use of tailor-made as opposed to mass-standardized textbooks.

The case of the textbooks is important and interesting. However, it must be recognized that textbooks in the educational sphere deal mainly with the informational function, and to a much lesser extent with the socialization and mobilization functions. Textbooks have not become more standardized in the United States because of the authority patterns related to their production and selection. There is still a wide variety of producing units, and the decision to select textbooks is highly decentralized. As a matter of fact, with the growth of sizeable specialized audiences, it becomes possible to develop a wide variety of textbooks and supplementary materials because there are large enough audiences to support each of the various developmental efforts. In fact, we see a strange organizational arrangement accompanying the growth in size of the student body. The authority relations in faculty groups are so organized--mainly at the university and college level--that instructors are able to maintain, and even to increase, their ability and responsibility to select materials for their needs. Technological developments make it possible for them to use a variety of materials which were not economic a decade ago.

These observations on the organizational aspects of printed text materials hardly imply that this medium is adequately organized and institutionalized to serve the needs of mass education oriented toward problem solving. The authority of the teaching profession to influence the selection and content of printed materials is still limited at the primary school level, and to a considerable extent at the secondary school level. Limitation on influence is felt particularly in schools not geared to preparing students for higher education.

The issue can be stated in other terms. The institutional framework of mass education for making decisions about the printed media operates mainly on the basis of the information function. There is a general lack of concern, knowledge, and evaluation of the socialization and mobilization functions. These functions require greater variety and flexibility of materials to meet the highly variegated school population. The requirements of the culturally deprived slums are particularly relevant. In these institutions, the content of printed materials must be adapted to highly specific cultural backgrounds if they are to be an effective basis for the socialization and mobilization functions. In Northern schools, Negro migrants from the South require different symbolism than Puerto Rican migrant children. It must also be recognized that these social characteristics undergo rapid change, so that mass-produced materials rapidly become outmoded. The teacher remains as the central repository of pragmatic knowledge to meet these needs.

In the typical mass public school system, curriculum planning and development is heavily concentrated at the level of the superintendent, yet the metropolitan school system must serve a great variety of audiences. Flexibility and decentralization can be pushed to the point where the classroom teacher becomes heavily involved in producing appropriate materials. Experimental programs have been started which give the teaching staffs of particular schols wide authority to develop text materials. These provisions require new patterns of authority, new concepts in the division of labor, and more extensive internal communications among teachers.

In turn, the process of decentralized curriculum construction makes possible extensive internal discussions among teachers which strengthen professional competence and clarify educational goals. The standard curriculum designed for middle class children is rejected under these circumstances. Clearly, these decentralized processes require specialized staff support of a technical nature. The formula which emerges shows a more appropriate balance between standardized materials and specialized requirements.

At the lower levels of the educational system, decentralization is needed to produce a more flexible use of printed materials. At the higher levels, problems center around the overprofessionalization of the academic specialities, and the sharp separation between academic specialization and professional schools. Today, all efforts to modify the authority patterns of higher education have failed to achieve greater and more effective internal communication within the university. In fact, since the end of World War II, even experimental projects have been abandoned as universities seek to increase their size.

The impact of the new media, especially of television, as a classroom medium, presents a markedly different pattern than the trends in printed mass media. The trends in authority patterns and in decision-making have generally been in the direction of a greater centralization of content and with an emphasis on standardization. In the case of television, this trend is due not only to inherent technological capacity but to the manner in which television is being introduced into the school system. Television is introduced from the top down by administrative decision. It is being developed by centralized organizations operating outside of the school system. The fact that these organizations are sponsored by tax-free foundations does not alter their highly centralized decision-making processes. Furthermore, these organizations are not subject to extensive review by professional organizations or by decentralized, elected boards.

As television becomes developed, the content of mass education is determined more and more by professionals who are concerned with the techniques of mass dissemination of messages rather than by specialists concerned with educational content. In other words, the division of labor shifts as new personnel are brought into mass education.

Moreover, in the absence of specific administrative policies and programs, the new media are most likely to succeed in their information tasks and least likely to succeed in their socialization and mobilization functions. Both of the latter functions require that the new media emphasize not only national symbolism, but also that they build in particular social, cultural, and local needs and aspirations. There cannot be effective national identifications without such attachments. The orientation of the new media tends to slight these social process requirements.

The educational system is also a school for citizenship, and not only in the sense that the student increases his intellectual powers. It is a school for citizenship in the direct sense that interpersonal relations and authority patterns in the school condition a student's attitudes toward the larger society and the political process. Training to take part in the democratic process begins in the school although, at this level, a student's responsibilities may indeed be limited. In the school, however, administrative procedures are crucial to his education for citizenship. If he recognizes and feels that his teachers have effective competence and authority, if he recognizes and feels that the equality of opportunity is an essential administrative principle, then he is getting appropriate citizenship training for a democracy. The introduction of mass media into the school may weaken citizenship training--if the media reduce the competence and authority of the teacher, or if they increase custodialism.

Professor William Ogburn asked repeatedly why his predictions that radio would fundamentally alter education institutions did not come true. He literally foresaw important aspects of high school and college being taught by radio. Radio failed largely because it was a medium which was too centralized for United States' social needs. It failed to solve the problems of interaction among faculty and students. It failed to adapt to the social organization of its audience. But, in the 1960's, educational radio is having a rebirth as it finds more limited and more realistic goals.

On the contemporary scene, the pressure to employ the new media, especially teaching machines and television, is much greater than it was during the emergence of radio. The pressure is so great that the new media will be developed and used regardless of social consequences. Unless there is adequate leadership and effective research, the new media will be developed without regard to their contribution toward custodial mass education. Despite such an apparent trend, there are already clues as to how the new media can be integrated into the mass school system in ways which maximize their beneficial consequences and contain their disruptive consequences.

Organizational inventions are developing which require careful study and evaluation. One type of approach is to reject the mass character of the new media, that is, in effect, not to use them to their so-called optimum economic advantage. Instead, one direction is to control the rate of social change, and to insist on employing technological devices appropriate to the task to be done. For example, in high school science, highly complex science equipment and demonstrations cannot be made permanently available to all schools for general education purposes. One alternative is to employ mass dissemination via classroom television. Another, and apparently more effective from the point of view of student involvement, is to employ mobile demonstration units backed up by appropriate audio-visual equipment which travels from school to school. Saturation by the media of communication gives way to more selective and more penetrating teaching procedures.

A second approach is to build effective organizational devices to overcome the dysfunctions of the new media. A basic proposition of sociological research is that, under certain conditions and with certain kinds of messages, a two-step flow of communication is most effective. In the case of the educational format, this two-step flow of communication involves specialized programs for teachers which supply them with supplementary materials. The teachers, in turn, select from these programs that which they can effectively manage, and that which they believe to be relevant for their educational assignments.

Another device is extensive training of teaching personnel so that mass television assignments can be rotated among a larger number of teachers. Such procedures have the effect of preventing television teaching from becoming routinized. In turn, teacher training and involvement in television teaching has the side effect of sensitizing those who must work with television transmissions on the receiving end. Still another approach is to formalize the feedback procedures of teachers in order to increase communication with the personnel who produce educational programs for television.

Finally, it becomes necessary to think of the social process limitations and potentialities of the new media. In these terms, for example, the greatest potential of television is not routine instruction. The power of this medium resides in its ability to bring to mass audiences outstanding personalities and crucial events. These elements are essential aspects of the socializing and mobilization function. If these functions are properly performed, the mass school system is led away from a custodial orientation to a problem solving one. The new media cannot perform this task unless there is a continuing effort to guarantee a decentralized process of decision-making about content--even though the new media themselves tend toward centralization.

Professional Implications of Research on the New Media

Much of the work in the application of social science research to the professional management of the mass media proceeds on the basis of an erroneous analogy with the natural sciences. The view is widely held that basic research in the social sciences is one function, while applied research is another function. Basic research is seen as prestigeful--if only because of its abstract formulation. Applied research is seen as less prestigeful because it is thought to be less precise.

In reality, there must be considerable unity between theory and practice if social science research is to achieve its goal of functioning as a component element in policy-making about the new media. This observation does not deny that, in the intellectual arenas, there is a social division of labor between researchers and professionals. It is to affirm that this social division of labor is not enough; there must be articulation among the elements.

No theoretical formulation is relevant until some significant empirical data have been collected. No body of empirical data is more precise and significant than that which is generated by field experiments and prototype efforts. If social theory has any relevance for the new media, then only by experimental and applied tests will one be able to judge the relevance of social theory. Finally, the model for research will not be a simple "before-and-after" model. Rather, it will be in the form of evaluative studies of the new media as institutions operating in a complex social environment.

For a moment, consider the intellectual process of social research as involving hypotheses formulation, data collection, and testing the adequacy of the original hypotheses. The analogy with the natural sciences would lead to the conclusion that the professional mass media personnel would be involved only after the hypothesis-testing phase of research has been completed. It is true that, at times, the investigator needs privacy and autonomy. Perhaps the sociological concept, marginality, best describes one condition for scientific productivity--but only one condition.

Communication among researchers and professionals is complex and subtle, and must take place under a variety of conditions in the research cycle. The researcher must fully understand the definition of the operational problem as stated by the mass media professional, even though he will restate the problem in his own terms. He will require the active cooperation of the professional in order to collect meaningful data. He will require the full cooperation of the professional to evaluate and to interpret the operational implications of the data collected.

There is a striking parallel between the problems of incorporating the new media into mass education systems and the problems of using research findings. In both cases, it is necessary to overcome the built-in danger that the results will increase uniformity in social behavior. Likewise, just as the new media must be organized to increase the competence and flexibility of the teacher, research results must be seen as the basis for personal initiative and creative problem solving--not merely as a new basis of rigid operating procedures.

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Implications of Theory for Research and Implementation in the New Educational Media

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Introduction

Strategy of this Working Paper

Four strategies come to mind for dealing with (a) the implications of the logic of science for theory development, (b) the implications of relevant theories for educational media research, and (c) the implications of both relevant theories and of educational media research for the formulation of educational policies and their implementation in educational operations. The four strategies are:

1. Formulate a theory of knowledge and action, observing the canons of the logic of science, and apply this theory to (a) the implications of media research and (b) the implications of relevant theories and educational policies.

2. Renege on the assignment and thus precipitate its assignment to someone else, or precipitate its disposal by Strategy No. 3, below.

3. Toss the problem into the laps of the conferees as the topic for buzz-sessions, for panel discussions, and for meat-and-drink group sessions in which intellectual capability is an exponential function of the chemical composition and volume-over-time consumption of beverages.

4. Redefine the problem and deal with it in the comfort of accustomed manner.

Strategy No. 1 is not possible within the limits of available time--and for a few other reasons which need not be spelled out.

Strategy No. 2 is particularly appealing, but the idea occurred too late to be applied gracefully.

Strategy No. 3 is the inevitable consequence of Parkinson's Law and of the rules of self-programmed conference behavior.

Strategy No. 4 is the most feasible choice. Moreover, it is justified by the principle of equitable distribution of difficulty and discomfort.

Rejected: Graphic Grand Scheme

The thought of integrating all of the theories previously presented into a sort of graphic Grand Scheme, and of deriving implications for educational media research and practice from this Scheme, occurred to me in early moments of wishful thinking. But, when realistically confronted, the facts of life in regard to the development of an integrated theory of individual and social behavior became unsurmountable obstacles.

Fundamental Difficulties

Unbridged Gaps

The difficulties encountered in the development of this paper--difficulties which are also fundamental to the overall problem posed for this Conference--can be reduced to a few classes of prevailing situations, conditions, and/or events.

One such class is the existence of critical gaps which prevent the integration of related, ordered knowledge and the sequential, interacting flow of theory, research, and action on the operating level of education.

Gaps exist (a) between the requirements of formal and partial theory formulation, and the actual formulation of theories; (b) between theories relevant to problems formulated for research in educational media, and much of the research which has been and is being done in educational media; and (c) between relevant theories and research in educational media, on the one hand, and the application of both, on the other hand, in the turbulent and complex institutional programs of education-in-action on all levels.

This gap structure is complicated by the fact that learning theory, communication theory, and sociological theory have been developed in isolation from each other--in varying degrees. Tribal organization and identification within the intellectual society of America give rise to fierce tribal pride, undiminished by the brawling and caterwauling among families and among individuals within families. Psychology and sociology not only have their own tribal language systems but their own dialects and dialectics. The yearling field of mass communication is expropriating its language system from other fields and is already beginning to show signs of tribal identity.

It is not the business of this paper to assume the role of a third- or fourth-rate C. P. Snow in discussing this alarming phenomenon. Its business is only to call attention to the fact that growing intellectual cleavages prevent or inhibit the development of a system (or systems) of thinking which we all agree would help us to cope with the problems of educational media as these problems actually exist on the practical level of formal, i. e., institutionalized, education.

There is reason to hope that this isolation, this separateness, in the realm of the rational ordering and the use of knowledge in a technology of education may be bridged, in part, by specialized disciplines of social psychology, educational psychology, educational sociology, and even educational communication. This hope is not easily negated by the fact that such specialized disciplines have either not attracted increasing numbers to the fold, or are showing signs of a withering of interest. Instead, it is fed by an increased demand for the services of people trained in these between-the-cracks specializations of the social and behavioral sciences, and knowledgeable in the complex, subtle, and elusive rituals and rubrics of institutionalized education.

For example, I was recently asked to recommend an educational psychologist for appointment to the staff of a division of academic research of an institution of higher education in another state. Upon extensive inquiry, I discovered that (a) such people as exist are carefully hidden away from raiding expeditions by the institutions in which they are presently employed, (b) institutions which provide such specialized training cannot meet the demands of the market, and (c) the pipeline of people-in-training shows few signs of expansion. Recently, a sociologist who has been especially active in formulating theory and doing research in the fields of mass communication and of education told me that his institution is unable to meet the market demands for educational sociologists. The demand exceeds the supply in these specialized fields of "applied" social science.

The notion of specialized disciplines to provide intervening mechanisms for bridging gaps among theory, research, and educational operations is introduced as a feasible way of establishing systematic interconnections. A range of more specific mechanisms will be discussed later in this paper.

Limiting Concepts

A second class of circumstances which cannot be ignored is that of the limiting concepts of (a) relevant theoretical formulations, (b) research methodology, (c) the nature of educational media, and (d) the central problem(s) of education.

Take, for example, the concept, educational media. This concept includes just about everything and almost nothing. All education involves mediating agencies and mediating channels.

Without such mediating agencies and channels, we are likely to produce a product similar to Itard's wild boy of Aveyron, whose halting and low-ceiling re-education is discussed lucidly and perceptively by Brown in Words and Things [1].*

What we actually include in the term educational media, is motion pictures, film strips, tapes, television, radio, transparencies, and "teaching machines"--to use the popular-unpopular shorthand term. We don't include books (including the new paperbacks), nor maps, nor charts, nor globes, nor workbooks, nor such other commonly used paraphenalia of education--without some sort of conversion of these exclusions into included categories.

The common element of the referenced educational media is machines. It takes a little stretching to consider a programmed book to be a machine, but for the sake of the argument, let it be so considered.

When we consider the part machines play in education, we are forced into a consideration of man/machine systems. When we consider man/machine systems, we are forced into a consideration of technology. By a process of progressive forcing, we advance to the broader concept of educational technology, or technology in education, as a central subject to which we must relate theories, research, and educational practice.

Professor Janowitz has called technology to our attention, just as the other resource people have called attention to aspects of learning, to communication, and to the logic of science. The point here is that the term, educational media, does not, in itself, suggest the ramifications for research and for educational policy and operating procedures which are inherent in the term, technology of education. Technology is not just machines and men. It is a complex, integrated organization of men and machines, of ideas, of procedures, and of management. The introduction of this complex organization generates many systematic problems which can be and have been ignored or generally neglected in theory, in research, and in practice in education. The term, educational media, limits; and the term, educational technology, expands the areas of theoretical development, research, and implementation in education. I have no quarrel with the broader view presented by Professor Janowitz, but this broader view must not be permitted to obscure or to diminish important elements which it contains.

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*The bracketed numbers which follow citations refer to the correspondingly numbered items given in the section, "Bibliography" at the end of this paper.

Full representation of all relevant disciplines and areas is not possible at a conference such as this one. While the agenda is refreshingly comprehensive in its scope and structure, the omission of formal consideration of priority problems of education and of the emerging "science of management" leaves us detached from our ultimate goal (improvement of educational efficiency and effectiveness) and from a basic element (management) of technology in education. This observation brings us to some of the limiting concepts of research in the field of educational media, or technology, and some of the limiting concepts of education itself.

It is frequently said by educators and educational researchers that the central problem of education is learning. Learning is a process central to human survival. The central problem of education is not learning but the management of learning. Learning and the management of learning are not equivalent terms, any more than are learning and teaching. The so-called teaching-learning problem is subsumed under the management-of-learning problem.

The papers presented by Professors Logan and Bettinghaus bear directly on the problem of the management of learning. Professor Rudner's discussion of explanation, prediction, and systematization as crucial functions of theory has obvious relevance to this point.

Let me illustrate the management-of-learning concept in one of its broader implications. We are currently investigating determinants of audience formation and reaction to early-morning college-credit courses taught over open-circuit television. Among the enrollees for credit in these courses, the implications of balance theory discussed by Professor Bettinghaus are manifest. The responses to the University offering the courses, to the professors teaching the courses, and to the presentation of the courses over television at the unseemly hour of 6:30 a.m. are generally favorable, although they vary in degree according to the extent of risk among the various audiences.

From an institutional point of view, a critical problem is that of attracting a greater number of people to enroll in the courses so that, among other things, tuition payments will reduce the deficit in the instructional budget incurred by the presentation of the courses over television.

The overall problem is much more complicated. It involves the responsibility of an urban university to serve the intellectual and the social needs of the community, the hour at which the program is offered, the selection of courses for presentation over television, and so on. But, central to the institutional problem, and intrinsic to the broad problem of the management of learning, is the fact that educational television for non-captive audiences is under-utilized. It attracts only a trivial percentage of its potential audience. Perhaps, as someone has been suggesting, viewing educational television programs of an academic mold between 6:00 and 7:00 a.m. is a status symbol. The viewers are status strivers. Published research, however, does not support this interpretation.

The motivational constellation of different audience categories is being investigated in our current research. Whatever the outcome, the fact remains that, whatever theory and research specify for improved management of learning via educational television, the relevant mechanisms can operate only when there is an audience in being and when this audience is of sufficient magnitude and/or composition to justify the costs of educational television. I am not suggesting a price on ETV viewer' s heads; but I am suggesting that costs must be justified.

This problem may be viewed as one of educational management. However, it may also be viewed as an operational problem of management of learning. Presumably, ETV viewers do learn. There is some reason to believe that the problem of management of learning becomes more acute when any aspect of new technology is introduced into education. Programmed instruction, for example, involves a high degree of control of the stimulus-response-reinforcement pattern, and a high degree of permissiveness in the rate of progress of learners. The former removes the classroom teacher from the direct teaching process. The latter transforms the teachers' functions so that management of learning on the part of the classroom teacher involves a new set of clerical activities, a new type of broad programmatic planning and administration, plus the selective introduction into the instructional program of a wider range of creative, analytical, and interpretive activities.

No matter which of the new educational media is introduced, the situation into which it is introduced is transformed by the introduction. Acceptance of management of learning as a central problem of organized and institutional education would, at least, permit the admission of a wider range of alternative procedures, techniques, and methods in teaching--without threatening or substantially altering the critical functions of education or of teaching.

Professional Party-line Conformity

A third limiting concept, particularly significant for this Conference, is to be found in the tendency among theorists, researchers, and practitioners to minimize risk in their professional careers by hewing closely to professional party lines and conforming visibly to them. This tendency acts as a strong force against the intrusion of "alien" ideas or procedures which, at least, deserve an open hearing, if not a good try. This limitation will be discussed in more detail later in this paper with reference to research methodology and to the functions of research in the field of education. Researchers are well-trained conformists. They differ significantly only in the cult to which they have been taught to conform.

Requirements for Improvement

Change, Development, and Conceptualization

Implied in the preceding discussion, if not made too explicit, is the proposition that relevant theories, theory-oriented research on the technology of education involved in the new educational media, and the application to practice of both relevant theories and/or research results, will not come to fruition without (a) changes in our ways of thinking about these problems, (b) the development of some intermediate mechanisms which will bridge existing gaps, and (c) a more comprehensive concept of the function of research on educational media.

At this point, two things should be made clear. One, the major changes, or new emphases, discussed below are, to me, the implications with which we should be dealing. The redefinition of the problem dealt with in this paper has been made in terms of these implications and in the ways in which they are interpreted. The authors of the other working papers have, it seems to me, pointed out some of the implications of their theories as they see them. It seems inappropriate to devote this paper to a discussion of the implications of the implications.

Two, throughout this entire paper, there is an underlying bias directing educational research toward educational operations [6, 7]. It is possible to dismiss this bias with unpleasant remarks about "educational engineering." It is also possible to sanction it by this same label. Educational research is not a closed system, nor a closed loop, in which theory generates research and research generates theory. Within the bias of this paper, educational research must have a primary use-orientation--if not sooner, then later.

Recommendations for Practice: Whose Responsibility?

At the Symposium on Psychology of Learning Basic to Military Training Problems [11], Gregory A. Kimble commented on some statements made by Ernest R. Hilgard in his paper on theories of human learning and problems of training:

> The experimental psychologist, in Hilgard's view, has neglected his responsibility to education. He has failed to validate his theoretical ideas in practical situations. He has shunned experimentation in the applied areas. He has largely ignored the contribution of those who do work in educational research. I object more strongly to what appears to be the

> basic premise here than to anything else in Hilgard's paper. So long as our science remains a democratic one, the translation of theoretical ideas into practically useful recommendations is no one's responsibility. It is the right and privilege of anyone who is interested. The same holds for experimentation. Tastes in such matters cannot be dictated. . . .

A great deal of water has flowed over the dam since 1953 when this symposium was held. Some viewpoints have changed in the meanwhile. The popular belief that there is a democratic science and non-democratic science has been shaken by the scientific output of nations and social systems which we think are not "democratic." Nevertheless, Kimble's statement regarding responsibility (non-responsibility) of the behavioral scientist for translating theoretical ideas into practically useful recommendations is probably accurate today, although it has been dented by developments in the field of programmed instruction in which psychologists have played a decisive role.

If this is not the responsibility of the scientist, then some mechanism must be developed which will get this job done. In an increasingly complex and interdependent world, laissez-faire is an outmoded social dynamic.

In this connection, it may be significant as well as suggestive to note that audio-visual educationists have been wearing a hairshirt--much as a tennis-player wears a T-shirt; and indulging in a rash of self-criticism for having failed, in one way or another, to become the technological middlemen upon whom the development of an effective technology (of new educational media) depends, at least, in part. Robert Lewis Shayon [10] added a quality of poetic writing and a sense of social identity and direction to this process of critical self-examination at the 1961 convention of the NEA's Department of Audio-Visual Instruction:

> The word "pandemic" was coined by Professor W. H. Cowley of Stanford University's department of education. . . . Professor Cowley asserts that three kinds of individuals are to be found in almost every society. The first is the "logodemic." He is the scout on the frontiers of knowledge, concerned exclusively with discovering new fragments of truth and adding them to the world's stockpile of knowledge. The

> logodemic is at one end of the spectrum. At the other end is the "practidemic" type. He is the individual who puts to practical use the knowledge discovered by the logodemic man. His job is to mediate between the other two types. This mediation is necessary because the logodemic man speaks an esoteric jargon which only other logodemics understand. . . .
>
> . . . .
>
> Pandemic man is the man who can get the general drift of the logodemic's ideas--translate them, and communicate them to the practidemics. The pandemic communicator must be a generalist. He must be able to catch the essentials of all the specialists' mysteries, without being contaminated by their parochialisms. He must be a student of his audiences. He must be schooled in esthetics. He must be a philosopher with the hand of a showman, the heart of an educator, and the spirit of a poet. Many of you may not aspire to such a combination--nor can any of us achieve the ideal. Yet as you educational technologists shape your future character you must recognize the importance of this member of your team--do what you can to train him for his work. . . .

Shayon not only specifies the requirements for, and characteristics of, the mediator between the discoverer and the organizer of knowledge and the practical man who is to apply this knowledge; he also adds the imperative, must, to the recognition of the importance of the mediator--the pandemic man in the field of media in education--and to the assignment of responsibility for his training.

Here then is the function, and here too is a possible social mechanism, for bridging the gap between theory and research, on the one hand, and the changes in educational practice which both imply.

Approaches to Improvement

Restraints of Research Methodology

A heavy commitment to the controlled experiment in research on media in education presupposes both the adequacy of theory and the range of insights involved in specifying theorems as hypotheses. Furthermore, such a commitment may very easily substitute precision for accuracy, where the latter is more relevant to the problems at hand than the former. Professor Rudner has pointed out the danger of this sort of confusion with reference to partial theory. It applies also to research, particularly in the field of media in education.

In the Summer, 1961, issue of Studies in Public Communication, Uliassi [12], its editor, went on record regarding "the discouraging gap which has developed between the breadth of insight, freshness of approach, and frankness of expression of the 'dissent' journals and the 'journals of opinion' and the narrowly defined, empirically researchable problems of the 'academic' journals in the field."

> What seems particularly needed is more research into the broad social and historical context in which communication media in fact have an impact. Our over-concern with research using the developed methods of controlled empirical investigation seems highly antagonistic, as others have noted, to insight regarding broader social processes at other levels of description and analysis.
>
> What seems to be needed in the communication field as in other areas of the social sciences is an increased recognition of the critical importance, for scholarship--and research--of seeking out the correct questions. What also seems necessary is a lesser "intolerance of ambiguity," encouraging creative and informed insights on problems whose social significance is approximated by their complexity. The problem is one of research strategy--and research priority.

The idea of seeking out the correct questions is not new, but the suggestion that a range of relevant insights is to be found in the analytical and critical writing of scholars from other disciplines is important in the sense that it underscores the importance to both theory and to research of broad insights and of different levels of insight.

In a provocative paragraph, Uliassi touches on the fundamental problem of precision and of the reflection of imprecision in research methodology:

> The basic question, and one which has, of course, been asked before, is whether the supposedly "hard" or "rigorous" studies are, in fact, those which are most precise. What seems to have been occurring is the substitution of one mode of imprecision, currently fashionable, for another, currently unfashionable. The imprecision of interpretive, multivariate, historical analyses of complex processes and problems has yielded to the currently more acceptable mode of imprecision: the imprecision of artificially-simplified studies whose narrow empirical character makes them only partially relevant to the actual social situation being studied. The case is analogous to that of looking under a street lamp for a coin lost in the forest--because the light is better there.

Scarcely one of us who has even a passing acquaintance with the research literature on mass communication and on media in education can fail to itemize a depressingly long list of studies which exemplify the currently fashionable mode of imprecision in which statistical design and analysis have been sophisticated but the results untranslatable into meaningful situational terms, or in which the problems investigated are either operationally insignificant or theoretically unrelatable.

The relationship between research methodology and the yield of insight is stressed by Fearing [3]. In his review of a study of effects of television crime-drama on children and adolescents, he discusses this relationship briefly, but in a vein not too dissimilar from that of Uliassi:

> There are, roughly speaking, two basic research designs for the study of the effects of the mass media. The first may be called the field design after the fact. The second is the experimental design where the attempt is to subject the

> hypothesized variables to systematic control. The first is exemplified by Cantril's study of the impact of the Invasion from Mars radio broadcast, and Merton's analysis of the Kate Smith bond-selling campaign on radio as reported in his Mass Persuasion. . . .
>
> It must be admitted that the field-after-the-fact type of investigation has yielded more significant insights into the social dynamics of impact than the meticulously controlled experimental study with its manipulation of variables and refined statistical analyses.

Commenting on the results of the study under review, which employed the latter (controlled experiment) research methodology, Fearing says:

> These results are solidly based and are certainly suggestive, but one cannot escape the impression that they are scarcely proportionate to the amount of effort required to design and carry out the research.

Many of us have made this same type of evaluation of many of the research studies in media in education, but generally in the informality of talk among close colleagues. Fearing's description of results as "solidly based" does not carry the same ring of conviction as that of the scriptural "house built upon a rock." The rock is there but not the house.

It may be oversimplifying and/or misrepresenting a significant difference between two types of research methodology, in field studies of the type cited, to point out that insights into social dynamics develop out of the analysis of the observed behavior in its broad and complex social context. In experimental research, the insights are essentially a priori requirements of hypothesis formation, deducible from prior theory or experimentation.

The narrowness of problems investigated by the experimental method, and the likelihood of hypothesis-blindness--which diverts attention from the alert observation of a range of behavior to the formalistic analysis of quantified data related only to the hypothesis--are sources of criticism of both the experimental method and of the neglect of the field study and other research methodologies. A wider range of research methods is required. Some of these research methods admittedly produce data which are imprecise and in which confidence must be based on other-than-statistical criteria.

Contextual research, i.e., research conducted within the context of the organization and operation of an existing instructional program, is a move in the right direction. As elsewhere noted [7], contextual research frequently uses "the controlled experiment to control variables which can best be controlled in the laboratory, and ignores many of the critical operating decisions involved in the art of teaching and in the art of educational administration." Yet, contextual research is one of those middle steps which are necessary to move research on media in education into the area of operation to which media research in education is practically relevant. Thus it provides a bridge between research and educational practice--if not between theory and research.

A newly emerging and significant development in theory-based contextual research in this field will be discussed later in this paper.

Principles Considered as Theoretical Constructs

Both research on media in education and the practical development of useful technologies of education can be facilitated by the recognition and use of "principles" which are relatively free of the distinctions and differences which exist among rival theoreticians. In the sense used here, principles are general statements, based on empirical evidence relatable to extant theories, on the operation of factors or influences in given situations or processes--such as learning, institutional innovation, etc.

Glaser [4], in a lucid paper on programmed learning sequences, points out that programming techniques utilize: "(1) the principle of reinforcement, (2) the principle of progression, (3) the principle of prompting, (and) . . . (4) the principle of fading and vanishing."

Hilgard [5] also points out a set of principles which "can be kept as reminders when practical applications of learning are under consideration." He itemizes a total of 18 such principles under the categories of S-R theory, cognitive theory, and personality theory. Here are a few: learner activity, cognitive feedback, goal setting, and group atmosphere. His statement on cognitive feedback, for example, is that it "establishes probabilities, and (in some cases, at least) is an appropriate explanation of effective reinforcement. The corresponding S-R principle is that of knowledge of results. The notion is that the learner tries something provisionally, and confirms his attempt by its consequences."

Such "principles" constitute highly generalized theoretical constructs which are not theory-bound in the sense that they involve the highly technical formulations of specific theories, and that they are relatively independent of competing theories which attempt to order and to explain the same behavior.

Bettinghaus based his stimulating and insightful discussion of implications of balance theory for media in education by converting variant theories into a "principle." Logan specifically talked about "principles of learning." The highly useful and relevant implications he specified, both for education in general, and for specific media in particular, were made by treating specific theoretical constructs in terms of principles. There seems to be little disagreement among those presenting papers on various theories that, at least for the immediate future, the implications of theory for research and implementation of media in education are more evident from principles intrinsic to the theories than from their more formal and technical constructs.

Theory-Related and Referenced Research

We now come to a stage of research which is both theory-related and referenced to prior research. For example, an experiment is referenced to a prior experiment(s) in that it is based on findings of previously reported research. It frequently involves "replication" under conditions varying from, but related to, those of the referenced experiment(s); or, it involves extension of a hypothesis (deduced from theory which may be implicit or explicit) to other conditions, other contexts, and/or other forms of manipulation of the independent variable, and to other dependent variables.

There are, to be sure, some media researchers who frown in disavowal of this "true" replication. There is good scientific logic to back up their unmasked frown. There are others, including myself, who are more interested in extending hypotheses relevant to education than in a logical requirement of exact or approximately exact replication which increases the verifiability of the hypothesis under identical conditions of only minor significance in the stubbornly practical world of institutional education.

To illustrate theory-related and referenced-experimental-research, considerable liberty will be taken with a report of a study by Kumata [8] of attitude change and learning as a function of the prestige of the instructor and the mode of presentation. Essentially, Kumata's study deals with "source credibility," a term dignified and promulgated by the late Carl I. Hovland and his colleagues.

Source credibility is derivable from communication theory as set forth by Bettinghaus. Anyone familiar with Cantril's study, The Invasion from Mars, and Merton's study of Kate Smith's radio war-bond marathon is aware of the idea that the "authority" of the source(s) interacting with the "authority" or "characteristics" of the channel (e.g., radio), has, under certain circumstances, a predictable effect on "audience" reaction.

Kumata varied the prestige of the instructors teaching a college course by having each described in rotating roles as a "national expert," a "departmental expert," and an "ordinary instructor." He varied the mode of presentation (channel) by face-to-face teaching and teaching over television. The results of the study are more or less as complicated and complex as the design of the experiment. No attempt is made here to summarize the findings. For our purpose, the significance of Kumata's study lies in the fact that it investigated the educational implications of both theory and of previously reported research studies on source credibility.

Purely as a matter of satisfying reader curiosity, it is noted that Kumata found that, in learning, face-to-face teaching was somewhat superior to teaching over television; that learning under face-to-face teaching or television teaching was consistent from instructor to instructor; and that teachers rated by students as varying in certain attributes related to "good" and "poor" teaching also "produced" informational learning in the same order as their rating by the students--whether in face-to-face teaching or in teaching by television. It is not clear as to how the theory of learned behavior accounts for these results--if at all. This lack of clarity is one of the bothersome gaps between educational "theory" and "learning theory." Yet, from an educational point of view, "good" learning is associated with "good" teachers. It is taken for granted (too little, to be sure) that one of the best sources of information on the "goodness" of teachers is the judgment made by their students.

Theory Derived, Operationally Significant Research

The two-step gaps between theory and educational media research, and between educational media research and improvement of educational practice are eliminated in one expert stroke when research is based on hypotheses derived from theory and when these hypotheses have a direct bearing on the character and cost of education on the level of practical operation.

Happily, this approach is increasing in educational media research. It is happening in the field of programmed learning. It is happening in the field of television and motion pictures in teaching. By coincidence rather than design, the illustration selected for discussion of this trend is taken from research done at Michigan State University--as was the research on source credibility discussed above.

Deutschman, Barrow, and McMillan [2] have recently published a progress report on a study comparing the effects of different modes of communication upon the relative learning of relevant and irrelevant information. In the prefactory note, it is pointed out that the report "proposes that ordinary classroom instruction is less efficient than a mass communications counterpart because it screens out less irrelevant material." This, itself, is significant of a growing sophistication in educational research in that the article "proposes" rather than it "proves."

The opening two paragraphs of this report are quoted below as an illustration of the process by which implications are derived from theory and applied to problems in education.

> The Shannon-Weaver model of the communication process . . . can be easily applied to the classroom or laboratory situation. The teacher can be equated with the communicator-encoder; the students with the decoder-receivers. The total complex of stimulation available to the receivers is the message plus noise. In most cases, this stimulation probably exceeds the receivers' capacity to decode.
>
> That part of the stimulation--including lectures, audiovisual materials, and discussion--which is relevant to the instructor's purposes, we may designate as message. That part of the stimulation which is irrelevant, we may call noise: This includes not only literal noise inside and outside the classroom but also irrelevancies intermingled in the lecture or audiovisual aids. Frequently, some parts of the stimulation which appear to be message are, in fact, noise; i.e., irrelevant to the communicator's purpose.

In developing the rationale (the implications of theory which have particular significance in terms of the technical nature of the "channel"), Deutschmann and his associates introduce a degree-of-focusing concept:

> If . . . we compare teaching by film or television with classroom or laboratory instruction, some differences are apparent. The film or TV situation may be designed to screen out some of the irrelevancies present in the natural situation. Or, if it does not screen them out entirely, it may reduce their intensity.
>
> For example, TV reproduction of a stimulus situation--classroom or lab--always loses a small amount of the original situation's detail. In many instances, the fine detail which is lost is part of the irrelevancies available in the natural situation. Film also is a means of focusing and/or reducing the intensity of irrelevancies. If a film version is shorter than a natural version, for example, the amount of irrelevant stimulation available will be reduced. While this reduction in a filmed counterpart of classroom instruction should be noticeable, it should be even more apparent in the counterpart of a laboratory situation, which seems manifestly richer in total stimulation--and particularly the irrelevant--for the student.

This interesting and significant research (reported with refreshing readability in a current issue of the AV Communication Review), involves comparison of instruction in "natural laboratory plus film," "film only," and "TV reproduction of film." The "degree of focusing" is hypothesized to proceed from minimal to maximum focusing, and "channel efficiency" is hypothesized to follow the same rank order.

The results of the research partially support the hypothesis that students exposed only to the film will obtain significantly higher "channel efficiency" scores than students exposed only to the natural laboratory condition--the only conditions compared in the research reported.

One might take issue with the coding-encoding concept as one of those intervening operations which cannot be observed by available research instrumentation. Or, one might find the concept troublesome in that it is dependent on a dictionary of equivalents which does not exist in the field in which the research is conducted. However, in the sense used in this reported research, the concept is heuristic and its use is convenient. Whether it is accurate or precise remains to be seen. My personal opinion is that it seems to promise more than it can comprehend.

There is another aspect of this reported research which deserves more than passing attention. The films used in the research study were produced either by or with the full cooperation of one of the departments of the University to whose instructional methodology it applies. This suggests that some decision will be or has been made on using films in departmental teaching. It further suggests that the research reported by Deutschmann and his associates may have a bearing on a departmental decision on the way in which films or television reproduction of films will be used in addition to the "natural laboratory," or as an alternative to some of the uses of the laboratory in the instructional program.

If these suggestions are realities, then educational media research moves from a primary concern with the extension and ordering of knowledge, to the use of this extended knowledge in decisions on educational operations. In this event, the two-step gap is being bridged.

It may well be argued that a great deal of the educational media research of the past has involved exactly this dual function as, in fact, it has. It may also be observed that researchers have, in fact, carefully concealed, suppressed, or ignored the relationship between research findings and policy-and-operating decisions in actual educational situations. This is one of the limiting concepts prevalent among researchers in educational media, and in the disciplines basic to such research, which was discussed in the first part of this paper. There seem to be rules against decision-making as a proper sphere of educational media research.

Orientation and Summary

Research and the Right Reason Thereof

The bias in this paper toward a use-orientation of research on educational media, as well as research in the general field of education, is by now clearly evident to the reader.

Knowledge relating to a field of action which is sought without committed interest in, or intention of facilitating action on, the practical level is very much like salvation by faith without good works. Good works are assumed to be the dynamically inevitable expression of soul-saving faith. Substitute knowledge for faith and action for good works and you stand in the shadow of yesterday at Wittenberg; or, if you prefer, in the sunlight of today's unsystematized division of intellectual and professional labor.

A totally different rationale of educational media research has recently developed among individuals and groups giving thoughtful consideration to research and development in the field of educational media, i.e., in the technology of education as it applies to programmed instruction, television, motion pictures, tapes, etc. This rationale is embodied in two sentences of a memorandum [9] related to the research and dissemination programs specified in Title VII of the National Defense Education Act of 1958:

> The preference should be given to projects which promise to move in an orderly sequence through the following stages:

a. Hypothesis discovery,
b. Hypothesis testing,
c. Field suitability testing,
d. Administrative logistics testing,
e. Program and media production, and
f. All-out demonstration.

Preference should also be shown to studies initiated anywhere in this sequence when it is demonstrated that earlier steps have been reasonably well accomplished.

This quoted statement needs no major elaboration. It shatters the illusion that theory is theory, and research is research, and products are products, and education-in-action is action-in-education, and that somehow, sometime, and somewhere, these elements will all fall neatly into orderly place without plan, or program, or systematic analysis, development, and integration. I regret to say that I simply don't believe that this illusion is anything but a comforting fantasy that relieves everybody of social responsibility--beyond that of self-definition, self-assignment, and "tastes."

I would add one more step beyond all-out demonstration to the progression: implementation in educational practice.

The Nub of the Matter

We now come to the nub of the matter. Let me crystalize it quickly in ten loosely formulated statements:

1. Neither cognate theory nor media research in education is likely to contribute significantly, either to each other, or, more importantly, to the improvement of education at the practical levels of policy and operations, if the happenstance relationships that now exist among these three areas of activity are perpetuated.

2. Cognate theories provide media researchers with a rich repertoire of conceptual tools very likely to improve the formulation of problems, and the relevance, the quality, and the appropriateness of research on educational media; but the theories

are so variant and disparate that careful selection among "principles" basic to the variant and disparate theories is essential to any fruitful media research program or project, although each of the theories is intrinsic to the problems of media in education.

3. While research on media in education involving a variety of research methodologies is likely to provide new and fruitful insights for cognate theories of learning, communication, and sociology, the primary responsibility of educational media research is to contribute directly to the formulation of educational policy and to the improvement of educational operations, both of which always occur on the local or regional levels.

4. This anchorage of responsibility implies a type of planning, organization, and programming of research that has not only been anathema to academic scholarship to America but also (until recently) has been viewed as subversion of "democratic science" in a "free society." A free society must be free to do what needs to be done as well as be free from the evils of self-defeating controls.

5. The status-quo-preserving assertion that educational operations are unique to each educational institution and, therefore, are not a proper area of research in general, and media research in particular, is exactly that and no more: a status-quo-preserving assertion.

6. Very little effect of educational media research on improvement of policy formation and operations in education at the action level is likely unless policy-makers and practitioners of education are consulted, involved, and made active participants in educational media research--both at its inception and in its prosecution. Mechanisms of social change can be built into educational media research, and suggested change, itself, should be one of the measures of the value of media research.

7. As long as different language systems are used exclusively by theory-builders, researchers, and practitioners, none of these groups is likely to communicate easily or effectively with the others. A common language is obviously missing but necessary in overcoming the language barrier.

8. Research in educational media is, in fact, research in education--not in psychology, communication, or sociology, as such. In this circumstance, the burden of proof is on the cognate theoreticians and on the researchers--discomforting as this requirement may be to both respected members of the academic community.

9. Education is a priority problem in the United States as well as in the world. The time has come to re-examine the hierarchical status system which assigns professional education and education research to the unspeakable bottom of the tribal totem pole.

10. If the interrelationships among theory, research, and educational implementation--implicit in the structure of the Conference and in the working papers and discussions--are to be strengthened, the training of educational media researchers must be broadened so as to include both the cognate theories and the curricula, the institutional structure, and the social organization of education. Rather than prescribe a longer period of graduate study for this purpose, the possibilities for on-the-job training of researchers in education operations should be explored.

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Part III

Presentations at the New Media Theory Conference

A Micromolar Approach to Education and the New Media 171

Toward the Reduction of a Difference-Signal 189

A Micromolar Approach
to Education and the New Media

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Introduction

Preface

There is clearly one problem with the familiar argument that a lecture is superfluous because it could better have been written and read, namely, there's little left to talk about. In the face of this problem, I have decided to go from one extreme to the other.

In the written paper, I attempted to deal extensively with the relationship between behavior theory and education, to mention briefly a substantial number of issues in the psychology of learning which seemed to have possible relevance to research in education--including research in the new media. Right now, I should like to select one constellation of these issues and, particularly, one facet of that constellation, and deal more intensively with it.

Preliminary Task

Before starting that topic, I would like you to participate in a brief task. I will tell you more about my purposes later. For now, you only need to know that I'm interested in group retention, as compared with individual retention, and as a function of the rate of information input and time since learning.

> [The speaker plays a tape recorder. The responses of the audience are recorded on synchrotrack. The recorded instructions to the audience are given below.]

This is a learning task for studying group retention. At the sound of a tap, I will read a list of common adjectives. After a pause, there will be another tap, at which time you are to say those words out loud in the same order as given. If you forget or miss a word, you should nevertheless reenter the report if you think you know a later word.

TABLE 1

Speed of Presentation of Lists of Common Adjectives and Recording of Audience Responses.

Speed	Recorded Adjectives
Slowly	cold, simple, big, yellow, straight, dark (Audience repeats list of adjectives)
Faster	nice, lazy, tall, hairy, separate, loose (Audience repeats list of adjectives)
Slowly	last, happy, great, his, open, hot (Audience repeats list of adjectives)
Increasing	bright, heavy, wet, blind, soft, good (Audience repeats list of adjectives)
Decreasing	sure, dirty, full, extra, soft (Audience repeats list of adjectives)
Faster	blue, strong, ready, late, shiny, easy (Audience repeats list of adjectives)

[The recorded adjectives are given in Table 1, above. The left-hand column indicates the speed at which the various lists were played back to the audience.]

Micromolar View of Learning

What Is the Nature of Learning?

One of the first questions on which a behavior theorist has to take a stand is, "What is learned?" Whether he's talking about a rat in a maze or a child in a classroom, or both, he has to make some assumption about what it is that an organism acquires as a result of practice. Fundamental as this question is, it cannot be answered empirically. However, data can be collected which, on balance, tend to follow most simply from one or another formulation. I would hope that a learning theory orientation to educational research--including new media research--would encourage dealing with basic issues of this kind so that practical questions could be answered by inference from a conceptual system--rather than, or at least in addition to, purely pragmatic research.

The first level at which one can attack the question, "What is learned?" concerns the essential nature of learning. Do organisms acquire cognitive maps of their environment and the relationships within it? Do they acquire information that reduces uncertainty about the world? Are perceptions transformed by learning into good Gestalts? Or are responses of the organism connected to stimuli?

The generation of research and debate at this level has failed to reveal any insurmountable defects in any of the foregoing approaches. I shall certainly not argue that good research can only be done within a stimulus-response frame of reference. I would argue that the very fact that cognitive analyses seem more natural to behavior as we experience it is, in reality, a disadvantage to the theoretically-oriented researcher--because he may tend to arrive at conclusions on intuitive, personal grounds. By forcing an objective description of the situation, a stimulus-response theory is more likely to reveal its own inadequacies and hence to develop into a complete and impersonal formalization.

What Is the Content of Learning?

In any event, I have adopted a stimulus-response approach and wish to turn to a second level of this question, "What is learned?" namely, what is the content, rather than the nature, of learning? Had I taken a cognitive approach, the question at this level would have concerned the content of cognitions; that is, what details of experience get absorbed into the organism's cognitive structure? Within an S-R approach, I am asking, what stimuli are hooked to what responses as a result of training?

Let me simply assert an answer: An organism learns best precisely that response, in all of its details, in connection with precisely that stimulus, in all of its details. Maximal evidence of learning will arise if the organism, insofar as possible, is permitted to do exactly the same thing in exactly the same situation. There will be a loss if the stimulus is changed or if the required response is changed, and the extent of the loss will depend on the extent of the change. Research, undertaken at this level of the question "What is learned" attempts to determine the range of generalization, the extent to which learning transfers from one situation to another.

Micromolar View of Response Speed

There is one aspect of the foregoing assertion that is not generally accepted by classical theories of learning and that, insofar as I know, is not adequately reflected in educational research and practice. I have selected this one for more intensive treatment--mainly because it is the one with which I have been involved in my own research. I also believe that this aspect has important practical implications because it concerns the speed of response.

The proposition which I have just stated assumes that response speed is part of what gets learned. This view is called the micromolar approach. It differs somewhat from the more conventionsl treatment of response speed. Classical theories define the response by its qualitative properties, by its topography, and treat its speed as indicating how well anything has been learned. This view is intuitively obvious in most everyday situations. You see a rat running a maze and observe that it takes him less time to get to the goal on successive trials. You quite naturally assume that his speed of running is an indication of how well he knows the maze. Or you observe a child doing arithmetic problems, and naturally infer that the faster he does them the better he knows them. This way of looking at speed is a part of our intuitive theory about the world and has been taken over in both psychology and education. However, this may be one of those cases where what seems obvious to everyday experience is not the most fruitful scientific assumption.

According to the micromolar approach, a rat running in a maze is learning how fast to run just as much as he is learning where to run. The reason he runs faster is not because he knows the maze better, but because he gets the reward sooner by running fast. Similarly, a child learns to add at the speed he's taught to add. He will add faster only to the extent that he gets better rewards by doing so.

Analyzing the Micromolar View

You might argue that the micromolar thesis, unconventional as it is in psychology, is already recognized in education. One case in point is reading. Remedial programs to teach speed reading are available in most colleges and many secondary schools. These programs tacitly admit that you don't learn to read fast just by reading. But even in this case, I would point out that the micromolar approach would be to teach reading better rather than to teach it in the same old way, and then to try to remedy the resulting product.

Moreover, the fact that the micromolar approach is not generally recognized among educators is more evident in the other two R's. The same methods of teaching which produce slow readers are also producing slow 'riters and slow 'rithmeticers. At least in our local schools, I see virtually no effort to provide remedial programs in these subjects, much less to modify the teaching methods themselves in ways consistent with an awareness that response speed is part of what students learn.

If the micromolar thesis is true, then it must have important implications for the way teaching materials are prepared.

To take a controversial example: teaching machines are supposed to have an advantage because they permit a student to work at his own pace. A micromolar theorist would not build a machine that way. Certainly he would agree the program must be geared to a student's ability--but this should be done in a way which would produce the desired speed.

I would like to see educational research, and closely related research such as research on the new media in education, directed first at evaluating and then at implementing the micromolar thesis.

Speed of Learning = Speed of Response?

Micromolar View of Learning and Responding

My natural inclination at this point is to retreat into the safety of data of the type which I have been collecting from rats during the past several years, and which have convinced me of the need for a micromolar theory. But instead, let me offer several observations about human behavior which you may find more convincing than my rats.

It follows from the micromolar theory that, if I present some learning material to you, you will tend to learn it at the speed at which I present it. Hence, you will tend to repeat it at that speed--unless other facters, such as forgetting and pressures of time, tend to override this tendency.

Analyzing the "Preliminary Task"

Let me play for you again the list of adjectives which you heard at the beginning of this presentation. Attend especially to the directions and convince yourselves that I did not say anything to imply how fast I wanted you to respond. At that time I recorded your responses on another channel. I would like you to hear now the extent to which your response speed was drawn away from your "natural" unison talking speed toward that which was presented in the materials.

[The speaker plays the tape recording of the exercise already described under, "Preliminary Task." This time, the audience responses to the exercise are included in the playback.]

I have done this exercise with several groups and with a number of individuals. Without exception they showed a tendency to mimic my speed of presentation. Of course, this outcome may vary with a number of factors. For example, the tendency to mimic probably is greater if the speaker has a prestige relationship to the listener. There are also several possible reservations about the theoretical meaning of these results. However, before dealing with them, let me note that, regardless of theory, just the fact that people tend to repeat things at the same speed as that at which they are presented is important when planning educational programs--or designing learning experiences, or developing educational materials. If you present materials slowly, students will repeat them slowly.

Trial by Ordeal

The tendency to mimic speed of input does not demand a micromolar theory. Possibly you could have repeated the lists as well at some alternative speed. Perhaps you repeated them at my speed only because you thought I wanted you to. The most convincing evidence that you cannot shift gears so easily is to try to do it. To illustrate this, surely all of you know the words to the Star Spangled Banner. I would like you to recite the Star Spangled Banner as a group. This time, if you miss a word or the tempo along the way, drop out so we can see how many can recite the entire piece. O.K.?? "Oh say can you see, . . ."

I hope that one's patriotism isn't impugned by not being able to recite our national anthem. I've never found a layman who could do it. Of course, I've also never found a layman who could sing it--but not because he couldn't remember the words!! As a micromolar theorist, I would argue that, when you've learned something one way, there's a loss when you're required to do it differently.

Formal Data on Learning and Response Speeds

In order to get somewhat more formal data on this proposition, I asked some students to run the following simple study. Subjects hear a list of eight numbers recorded at either a fast or a slow pace as timed by a stimulator. They are then asked to repeat the list in the same order and at a speed dictated by the stimulator. This output (response) speed might be the same as the (input) speed at which the list was presented, or it might be different. The simplest micromolar prediction is that the subjects will do better if the required output speed is the same as the input speed.

To help you get a feel for the nature of this task, I will play several minutes of the tape. Unfortunately, you can't participate out loud because different people get in the response tempo more quickly than others. However, you might try repeating the lists to yourselves as required by the task. . . .

> [The speaker plays a part of the tape-recorded instructions for this study. As suggested, the audience participates silently.]

This study is still incomplete. The differences which have been obtained are not very large. The data available at present are given in Table 2, below.

TABLE 2

Per Cent Correct Recall of a List of Eight Numbers for Fast and Slow Presentation and Recall Speeds

Input or Presentation Speed	Output or Response Speed	
	Slow	Fast
Slow	55%	47%
Fast	50%	51%

Starting in the upper left cell of Table 2, the percentage of correct recalls was 55 per cent when the stimulus presentation speed was slow and the required response speed was slow. When the presentation speed was slow and the required response speed was fast, the percentage of correct recalls dropped appreciably to 47 per cent. This difference was expected. However, it could be due, at least in part, to the fact that fast responses are simply more difficult than slow responses. That the difference is not entirely due to this fact can be seen from the lower right cell, which also refers to lists which the subjects had to repeat fast but which had been put in fast rather than slow. In this case, the percentage correct was 51 per cent, which is somewhat greater than the value obtained when the input speed was slow. The lower left cell refers to the recall of material which was put in fast while the required recall speed was slow. The percentage correct was 50 per cent. Again you see that, if the output speed was slow, the subjects did better if the input speed was also slow.

There are several possible reasons why the obtained differences are so small. The most important of these reasons was the inclusion of subjects who got the lists all right because their memory span was substantially longer than eight--or they got them all wrong for the opposite reason. In either case, the effect was to drive the cells of Table 2 toward the same value. My clearly biased guess is that this study will work out in the way predicted by a micromolar theory as we collect the rest of the data and analyze them further.

Potentials of Micromolar Theory

Explanation and Generalization

To illustrate how the findings just described can be rationalized by a micromolar theory, let us make the assumptions developed sequentially in four illustrations.

The first one, Figure 1 on the next page, graphs the assumption that fast responses are more difficult to perform than slow responses. That is to say, for the same level of learning,

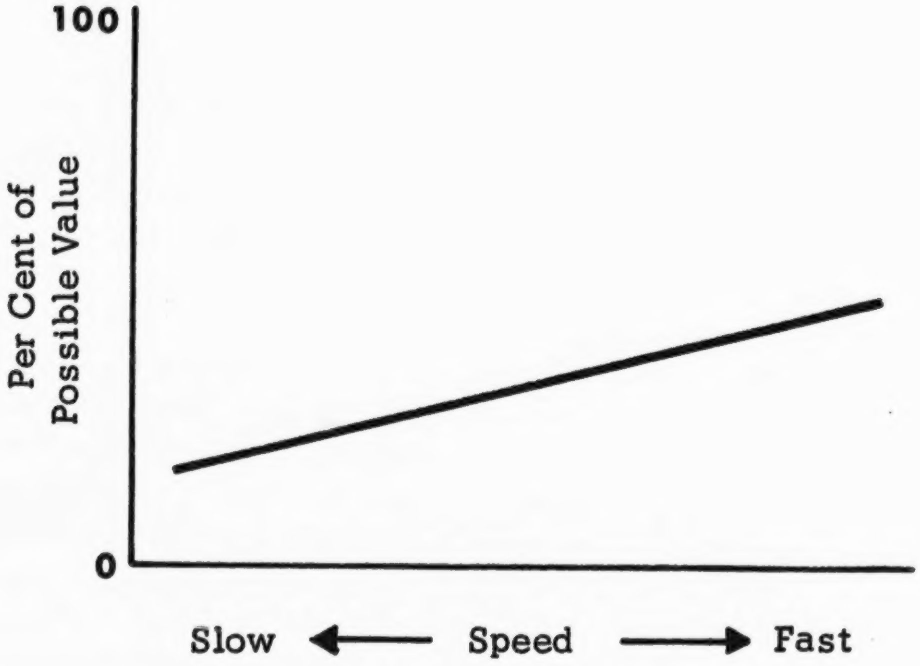

Figure 1.--Difficulty of Performance: Fast responses are more difficult to perform than slow responses.

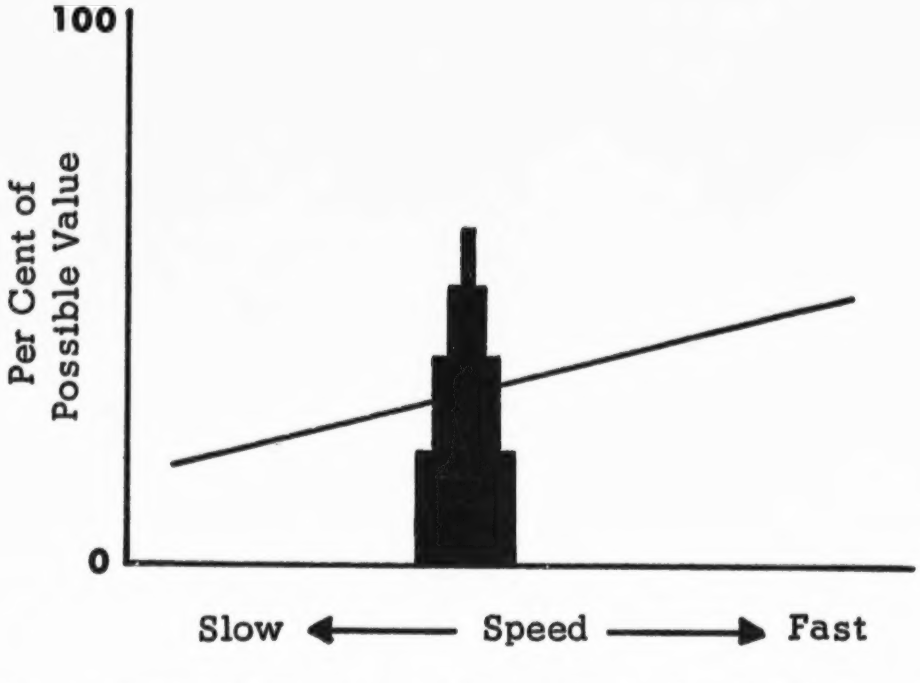

Figure 2.--Level of Learning: Learning is focused on a particular speed, and learning per trial diminishes.

performance is poorer the faster the required speed of the response. Note that I have not specified units along the baseline and hence am using straight lines only for purposes of illustration.

The second illustration, Figure 2, preceding, pictures the micromolar assumption that learning is focused on a particular speed. It also indicates, by the stairstep arrangement, that the amount of learning per trial diminishes, and that it is probably some fraction of how much there is left to learn.

The third illustration, Figure 3, below, notes that, although learning is principally focused on the speed of presentation, there is generalization to other speeds. This point is the one which separates micromolar from more conventional theories. Conventional theories assume that the amount of learning is the same regardless of practice speed.

Finally, the fourth illustration, Figure 4, following, shows that the level of performance is the difference between the level of learning and the level of difficulty involved. A subject trained at an intermediate speed and tested at a faster speed suffers both because he has lost some learning due to a change (increase) in speed and because he has been shifted to a more difficult task. When tested at a slower speed, however, these factors work in opposite directions because the shift in speed produces some loss in learning but also some gain because the required response is an easier one. The result depends on the slope of the two functions. As they are drawn, the shift to a slow speed would lead to an increase in performance because the loss of learning is less than the gain from the lower level of difficulty. Such a model can handle all of the differences shown in Table 2, above. The more conventional type of theory implies that performance depends only on output speed, which is probably not true in fact. Accordingly, I believe that people, as well as rats, are built on a micromolar principle.

Application in Research and Practice

If one adopts a micromolar approach to education, and to the new media in education, then an important practical problem arises: What is the best training schedule to follow in trying to produce fast responses? This is not a problem for conventional approaches

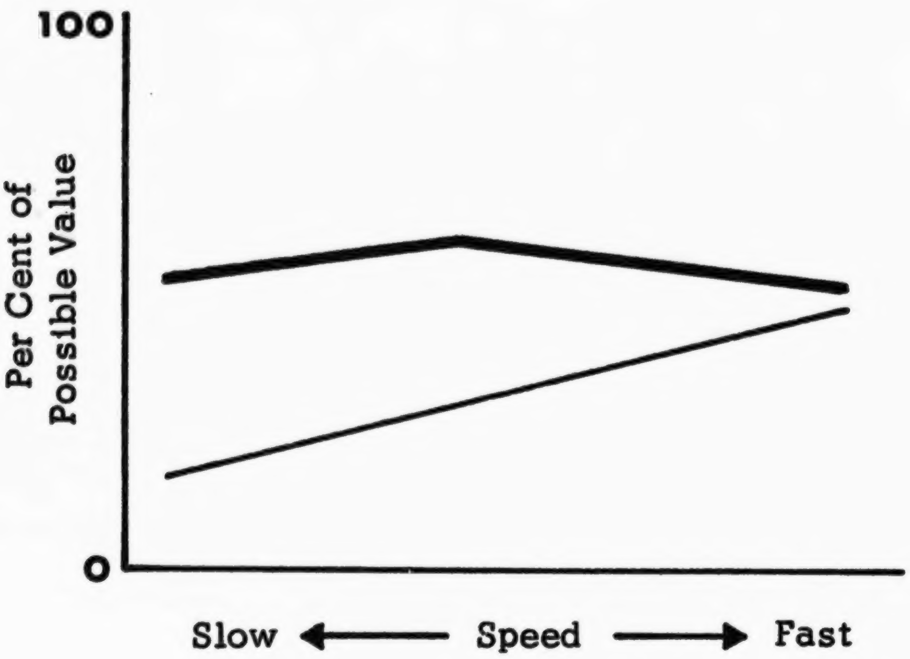

Figure 3.--Generalization of Learning: Although learning is focused principally on the speed of presentation, there is some generalization to other speeds.

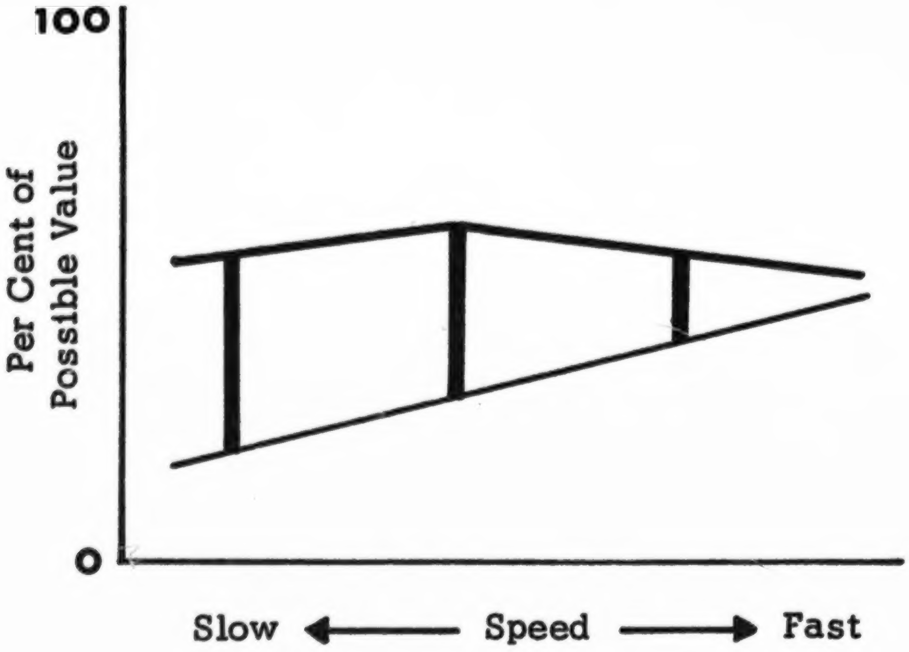

Figure 4.--Level of Performance: The level of performance is the difference between the level of learning and the level of difficulty.

because learning is assumed to be the same regardless of the practice speed. But if learning does tend to be related to practice speed, then it makes a difference how fast practice is given.

The pragmatic approach to this type of maximization problem is to try out every imaginable schedule in the hope of finding the solution empirically. A more efficient procedure in many situations is to develop a learning model of the task, and then to track down the best schedule by deriving predictions from the model about the relative effectiveness of various schedules.

In order to illustrate this approach, I followed one of the oldest traditions in verbal learning and used myself as a subject. I learned a series of paired-associates tasks. Each task contained five pairs, the stimulus element being a nonsense syllable and the response element being a number between one and five. The criterion task was recorded on stereophonic tape, with the stimulus and the response elements appearing on separate channels at a rate of about one per second. The task was to anticipate the response element before it appeared in the program. To give you a feel for the nature of this task, I will play a few trials at criterion speed.

> [The speaker plays the "fast" list of paired-associates recorded on stereophonic tape. The instructions given: "To the stimulus word appearing in this channel, you are to say the response number before it appears in the other channel."]

I also recorded the same pairs at a slower speed, precisely one-half as fast. This is a much simpler task, as you will see. . . .

> [The speaker plays the "slow" list of paired-associates recorded on stereophonic tape. The instructions are the same as for the "fast" list, above.]

The question I asked is straightforward: How many times if at all, should I hear the slow speed before shifting to the criterion speed to complete the learning? The micromolar model makes a clear enough statement in this regard: Practice at the slow speed as long as the amount of learning is enough greater at that speed (than at the fast speed) to more than offset the loss of learning which will result from the shift to the fast speed. This statement is not of great immediate value because it can make a unique prediction only if one knows the relative rates of learning and the degree of generalization for the task.

However, these values can be estimated fairly easily. After learning a dozen lists of this kind, I estimated that: (1) the fast speed was twice as difficult to perform as the slow speed; (2) the learning rate at the slow speed was about 30 per cent per trial, and about 20 per cent per trial at the fast speed; and (3) there was approximately 80 per cent generalization of learning from one speed to the other. These values yield the following solution:

1. In order to minimize number of trials, the best training procedure is to hear the slow speed three times and then to shift to the fast criterion speed.

2. In order to minimize time to learn, rather than number of trials, the best procedure is to start right out on the fast list because, although the amount of learning per trial is considerably less, two fast trials can be completed in the time required for one slow trial.

I do not wish to dwell on the details of this little study and certainly do not want to generalize very broadly from it. The task is somewhat artificial, although it is perhaps similar to learning the multiplication tables. But there are a large number of factors and schedules one would want to deal with before even attempting a general answer to the question of the optimal schedule for training for fast responses. It seems to me that this problem is vital for educational research.

Micromolar View of Practical Problems

The question, "What is learned?" should really be considered in relation to the question, "What should be learned?" I have quietly finessed this second question by talking about tasks such as addition and multiplication where, other things equal, the faster the response the better. But this is not always the case. Talking, for example, isn't something we should do as fast as possible.

Looking at what is learned in relation to what should be learned, an ideal organism would probably generalize somewhat more broadly than it should--in the sense that occasionally it would respond inappropriately. Such an organism would always respond where appropriate. The overgeneralizations would be eliminated by the process of discrimination. There is no comparable mechanism to "correct" responses in an organism which undergeneralizes. People may be built more-or-less ideally for various motor adjustments to the outside world, but my guess is that this is not true for verbal behavior. We learn language under conditions favoring fine discriminations. One result is that educators are faced with students who may learn the specific message being communicated but who fail to see in it anywhere near all of its implications. Possibly, the teaching of semantics, epistemology, and philosophy in the primary grades would improve this situation--but that is only a speculative hunch.

Perhaps the tendency to undergeneralize verbal material can be both illustrated and, if necessary, counteracted using the micromolar message. Surely it is clear that a micromolar theory assumes that fast responses are different from slow ones. Let me pose a few situations to which this thesis is relevant. You may judge for yourselves how likely you would be to have observed this relevance.

Let's start with an easy one. You hear your daughter at the piano practicing the Minute Waltz at a speed such that it would take about ten minutes to play the piece. What would a micromolar theorist think? He would at least recognize that the child is not practicing the final task, and he would wonder whether there isn't a better schedule.

Here's one that goes in the opposite direction. You attend a water carnival and are amused when the free-style expert is enticed into the pool by a ballet swimmer, and then flounders trying to follow her strokes. What would a micromolar theorist think? He would hold that there may be a family resemblance between swimming fast and swimming slow--but that the relationship is on the order of fifth cousins! Most of us learn to swim fast and to keep from drowning. We find it difficult to swim slowly.

Suppose that a typing teacher plots a learning curve for her class, and learns that speed increases with practice to a reasonably stable level. What would a micromolar theorist think? Very likely, he would observe that a performance curve doesn't measure learning, because the fast responses near the end are different from the slow ones near the beginning. He would also observe that the stable level may only be a plateau based on the prevailing training conditions, a plateau which could be surpassed readily enough if the conditions were changed to provide greater differential reinforcement for fast speeds.

Here's a problem which many of us have faced, or will face, within our families: A person continues to walk fast, to climb stairs fast, even to talk vigorously--in spite of the fact that he's had a heart attack and has been warned to slow down. What would a micromolar theorist think? He would think that such a person has to unlearn fast behaviors and to learn slow behaviors; and that this kind of learning requires explicit training and is not accomplished simply by instructions.

Suppose you read my Conference working paper and note that, for example, thinking is treated as a response. What would a micromolar theorist think? He would think that the thesis applies to all responses, including thinking. Even behaviors as complex as reasoning and problem solving take place at a learned speed--which can be changed by training.

Suppose that you encounter a discrepancy between scores on a speed test and scores on a power test, and have to decide which to use. What would a micromolar theorist think? He would think that a speed test doesn't measure who knows the material the best, but who has learned to do it the fastest. Of course, this may be important for some purposes.

As a final example, what would a micromolar theorist think about the expression, "Haste makes waste"? He would say, "Haste makes waste only for people who haven't practiced responding hastily. Virtually everything we do, from shaving to eating to going to sleep, is done at a characteristic speed. It suffers if we try to do it faster. But the real, long-term wastemaker is to continue to perform at those slow speeds which we learned from parents and teachers who believed that the important thing was to learn what to do, and that you then would just naturally go on to do it as fast as you could. The micromolar thesis is that this assumption is not true, that you're teaching speed whether you want to or not, and that you should take this fact into account when planning educational experiences.

Toward the Reduction of a Difference-Signal

Henry A. Bern
Audio-Visual Center
Indiana University

Introduction

Forthright Strategy

Some of the preceding speakers introduced their papers with a frank discussion of their strategy. I shall follow this precedent. I wish to state that the kind introductory remarks, the ones asking you to sympathize with the fact that I undertook this assignment with but a week's notice, are the whole of my strategy. No more complicated strategy is required for I am allying myself with the majority which has been trying to understand in six days what four resource people have tried hard to obscure over a period of six months.

In the role of a hurried and harried participant, then, I shall try to voice some questions which still remain--despite the labors of the resource people. In doing this, I shall heed the advice of the poet who said:

> Not to the rolling heavens cry,
> Nor to the experts turn for why;

But of thyself, stumbling in the dark
Of thy hypothesis, ask questions till thou die [19].*

Bear With Me . . .

On this happy note, I ask you to bear with me on several matters:

1. Since I had but six days in which to prepare, I shall address myself to the pre-Conference working papers received last week rather than to the oral presentations of the past day or two.

2. For the same reason, the pictorial materials--quickly designed, begged, borrowed, or stolen--should not be regarded as reflecting the true value of the "new media."

3. For the same reason, some of my references to the resource people may not be clothed in as professionally polite dress as they should be. They are, however, addressed ad verbum and not ad homimum.

Analysis and Interpretation

The Reality

Before receiving the pre-Conference working papers, I studied the illustration of the content and organization of the Conference contained in the document, "Conference on Theory for the New Media in Education." The chart in question is reproduced in Figure 1, following. I think it is clear and well done.

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*This number, and others like it, refers to the corresponding item listed under "References" at the end of this paper.

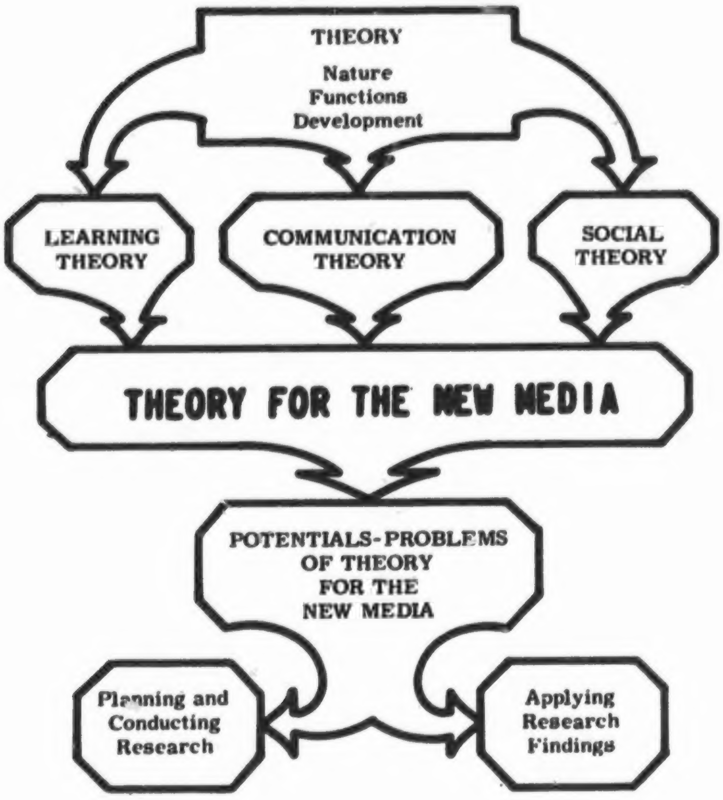
THEORY
Nature
Functions
Development
LEARNING THEORY
COMMUNICATION THEORY
SOCIAL THEORY
THEORY FOR THE NEW MEDIA
POTENTIALS-PROBLEMS OF THEORY FOR THE NEW MEDIA
Planning and Conducting Research
Applying Research Findings

Figure 1.--Content and Organization of the Work Conference on Theory for the New Media in Education.

First Interpretation

I noted, however, that the Theory Conference was to be held under Title VII, Part B, National Defense Education Act. Consequently, I interpreted Figure 1 as shown in Figure 2, below.

The difference between Figure 1 and Figure 2 is indexed by two features: (1) the relative size of the words, "new media," and (2) the relative intensity of the "integration" arrows. It may be fairly inferred that I perceived that the primary content (stimulus) of the Conference was to be a concern with "new media"; and that the primary activities (criterion responses) of the Conference participants and resource people were to be focused on integrating theory, research, and application.

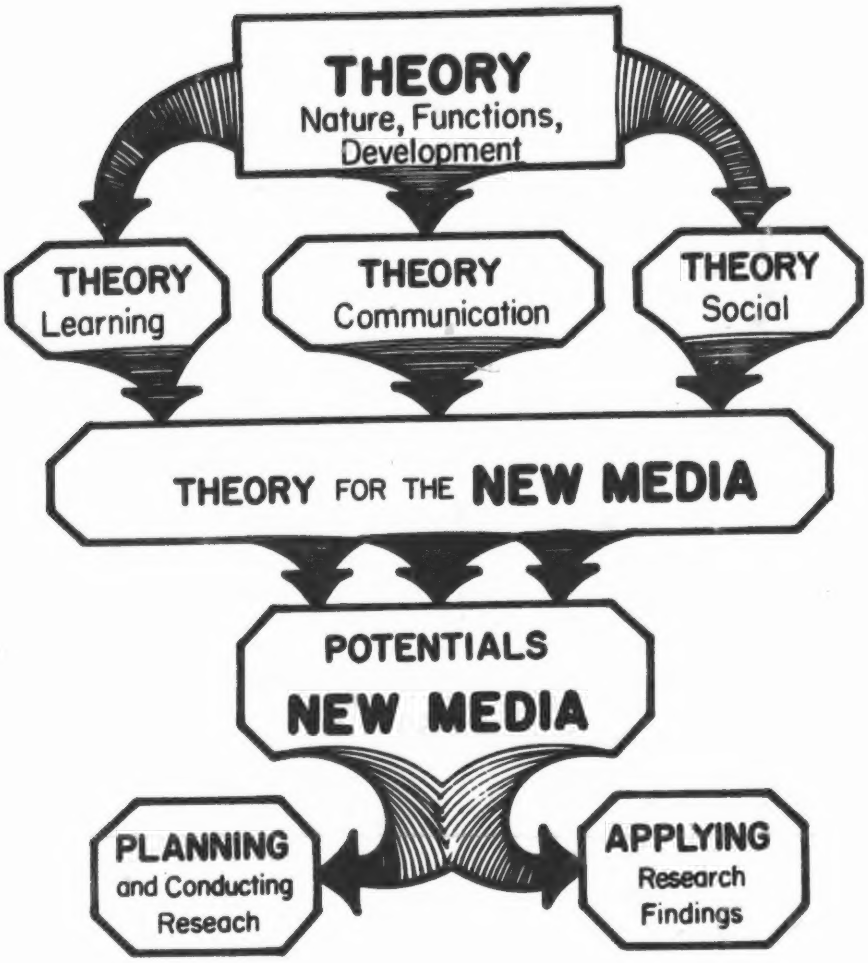
THEORY
Nature, Functions, Development
THEORY
Learning
THEORY
Communication
THEORY
Social
THEORY FOR THE NEW MEDIA
POTENTIALS
NEW MEDIA
PLANNING
and Conducting
Reseach
APPLYING
Research
Findings

Figure 2.--Interpretation of the Conference Structure, Content, and Process Illustrated in Figure 1.

Second Interpretation

After I had received the working papers, I perceived the actual design of the Conference in another way. Figure 3, below, illustrates this interpretation--a clear-cut example of abient or avoidance behavior! !

Difference-Signal

A number of terms used in connection with models already presented to us can be used to conceptualize the difference between Figure 2 and Figure 3. For example, "dissonance," "incongruity," and "imbalance," appear to be suitable. However, as Hoban points out, in our society everyone is (unfortunately? ?) permitted to use

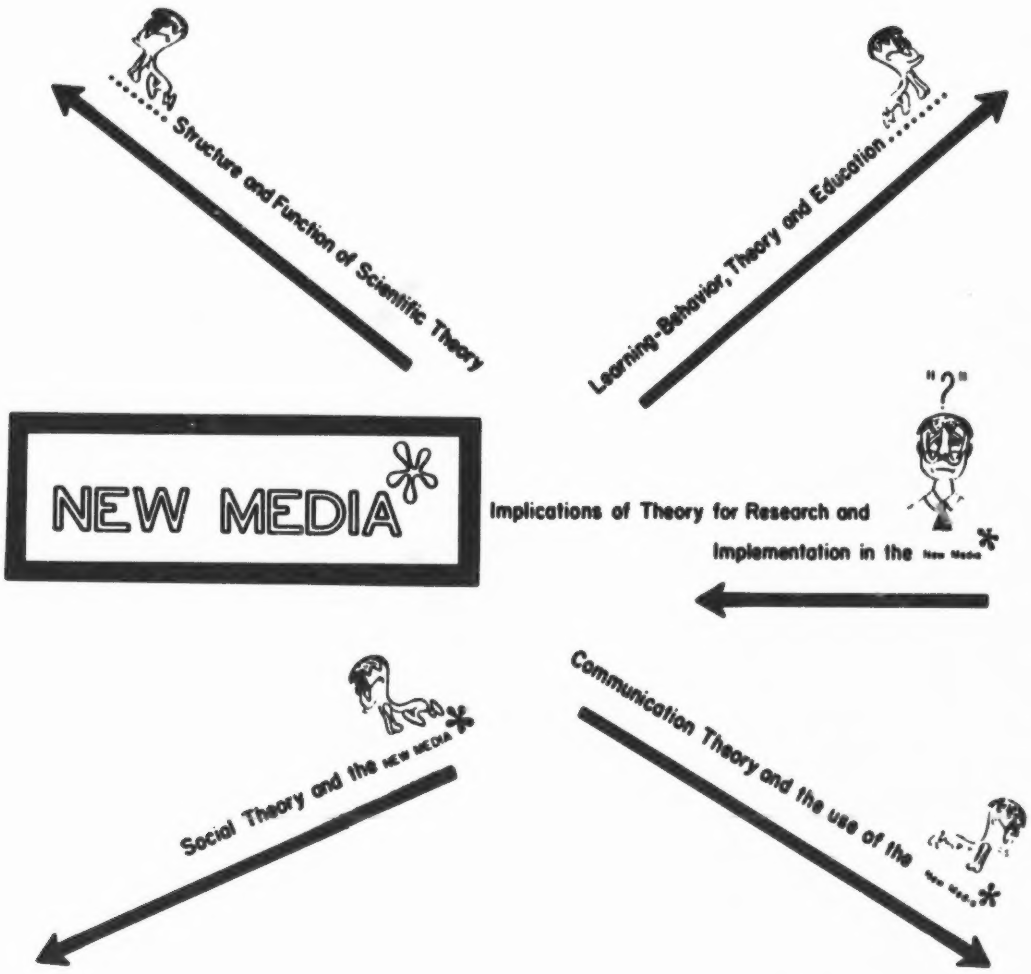
Structure and Function of Scientific Theory
Learning-Behavior, Theory and Education
"?"
NEW MEDIA*
Implications of Theory for Research and
Implementation in the New Media*
Social Theory and the NEW MEDIA*
Communication Theory and the use of the New Media*

Figure 3.--Avoidance Interpretation of the Conference Structure, Content, and Process Illustrated in Figure 1.

his own language. Exercising this prerogative I wish to use the word "difference"!! To impart a communication flavor, I combine "difference" with "signal." The whole expression then becomes "difference-signal."

Please note that this is not sheer whimsey. The question of whether the use of "difference-signal" (in lieu of, let us say, "imbalance") implies a signal difference is of fundamental interest to this Conference. It is considered in detail later.

Purpose and Method

The purpose of the remainder of this presentation is to reduce the magnitude of the difference-signal which I have just defined.

To specify further, there are two components in the difference-signal: a new media component and an integration component. In general, I shall try to reduce both of them by asking certain questions and by proposing possible answers.

More specifically, I shall try to reduce the new media component by asking questions such as the following:

> What do we mean by the "new media"?
> How do the "new media" differ from the "old media"?
> What do we mean by a theory for the media, new or old?

Possible answers to such questions will serve to redirect the connotations of "theory" towards an emerging concept, "educational technology." The latter concept, I should add, encompasses both the "molecular" and the "molar" views of the new media.

Reduction of the integration component of the difference-signal will be approached by asking the question, "How may any model (or theory) or group of models (or theories) be evaluated?" Suggested answers to this question will take the form of a rudimentary list of evaluative criteria. These criteria will be abstracted from the Conference working papers, from the Conference presentations--to limited extent, from research reports, and from the general literature on theory.

The New Media Component

New Media = Hardware???

We shall begin, then by asking: What is this thing called "new media"? Our Conference outline tells us that, for the purposes of our discussion, the term may be used as defined by the Congress of the United States in Title VII, Section 701, Public Law 85-867. In this sense, the term "new media" is defined, by denotation, as ". . . television, radio, motion pictures, and related media of communication. . ." and ". . . motion pictures, video tapes and other audio-visual aids, film strips, slides and other visual aids, recordings (including magnetic tapes) and other auditory aids, and radio or television program scripts. . ." From this description, it seems that "new media" is a collection of consumer items which might just as properly be called "appliances" or "hardware."

Notice that, in the foregoing list, items ranging from something as simple as a photograph to something as complex as an interstate television network, are denoted as implying a concept called "new media." Although Congress may have thus defined "new media," it certainly did not ask us to develop a theory for it! This assignment, I take it, was our own bright idea. Consequently, it behooves us to ask what we could possibly mean by a theory for such "hardware."

A Look at Some "New Media"

According to Dr. Janowitz, we can find answers to many questions by "just looking." Although this advice may be highly debatable as a general research strategy, it does serve our immediate purposes. Let us look at some of the physical referents of the terms used to define "new media." A collection of such referents is presented in Figure 4 on the next page.

What do you see? Anything new?? As a matter of fact, we borrowed this collection of instruments and devices from colleagues who were using them for years before the National Defense Education Act was agleam in anybody's eye. To my colleagues, they were simply elements of the armamentarium of Audio-Visual Education. We recognize them as devices which have existed for decades. The term "new media," then, is a misnomer, but it is used in a context which does connote something "new"--and significantly so!

A Purposeful Exercise

To discover this connotation, let us look at a portion of Section 701 of Public Law 85-864. Now substitute the letter "X" for the term "new media," and for any terms subsumed by it.

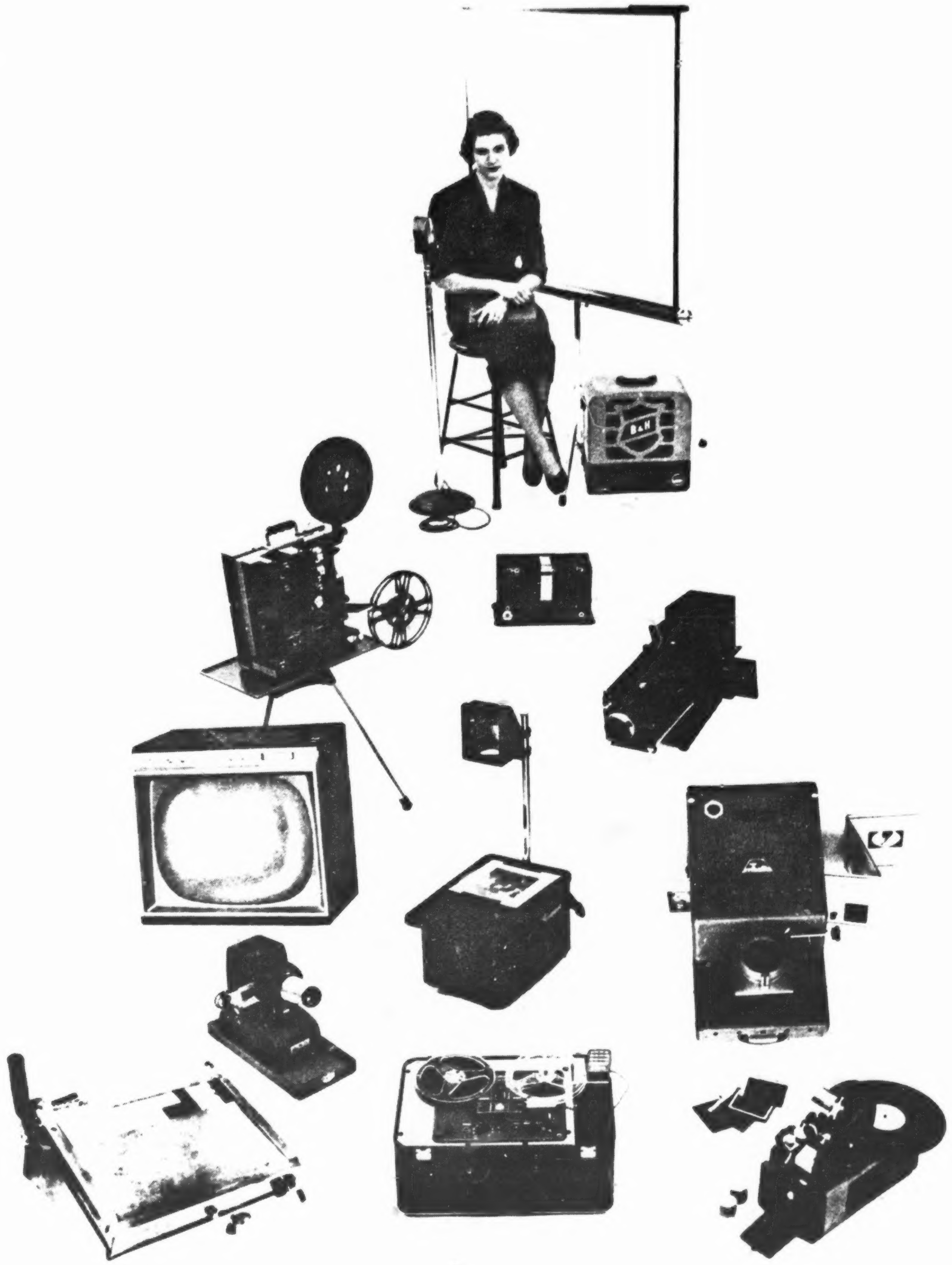

Figure 4.--Are These Things "New Media"? ? ?

TITLE VII--RESEARCH AND EXPERIMENTATION IN MORE EFFECTIVE UTILIZATION OF TELEVISION, RADIO, MOTION PICTURES, AND RELATED MEDIA FOR EDUCATIONAL PURPOSES

PART A--RESEARCH AND EXPERIMENTATION

Functions of the Commissioner

> SECTION 701.--In carrying out the provisions of this part the Commissioner, in cooperation with the Advisory Committee on New Educational Media (established by Section 761), shall (through grants or contracts) conduct, assist, and foster research and experimentation in the development and evaluation of projects involving television, radio, motion pictures, and related media of communication which may prove of value to State or local educational agencies in the operation of their public elementary or secondary schools, and to institutions of higher education, including the development of new and more effective techniques and methods:
>
> (1) for utilizing and adapting motion pictures, video tapes and other audio-visual aids, film strips, slides and other visual aids, recordings (including magnetic tapes) and other auditory aids, and radio or television program scripts for such purposes;
>
> (2) for training teachers to utilize such media with maximum effectiveness; and
>
> (3) for presenting academic subject matter through such media [27, p. 16].

Notice that the title of the section itself now becomes, "Title VII--Research and Experimentation in More Effective Utilization of X for Educational Purposes." Continuing the substitution, we note that the Commissioner of Education, in cooperation with the Advisory Committee on New Educational Media, is ordered to do that ". . . which may prove of value to State or local educational agencies. . .including the development of new and more effective techniques and methods:

1. for utilizing and adapting X for such purposes;
2. for training teachers to utilize such X with maximum effectiveness; and
3. for presenting academic subject matter through such X."

The particular purpose of this exercise is to support the argument that what Section 701 seeks is new uses of X. In reading and substituting in this Section, I have deliberately emphasized the terms involving and implying use. However, I believe that even a neutral reading would clearly support my interpretation. I repeat then, that, according to Section 701, it is not new X with which we are concerned. On the contrary, we are concerned with new uses of X, and/or with new techniques for the use of X.[1]

Educational Engineering

If we accept the foregoing interpretation of the intent of Section 701, then the "educational engineering" framework, which Hoban acknowledges as a personal bias, becomes an appropriate framework. "Engineering" is generally defined as, ". . . the art and science by which the properties (of materials) are made useful to man in structures, machines, and manufactured products"[32]. Our concern with the art and science by which the properties of our new media (in their composite forms) are made useful to education suggests that the theory which we seek is the theory of an emerging field concerned with, or even bearing the label of, "educational engineering."

---

[1] An interesting parallel argument is presented by M. Sidman in Tactics of Scientific Research, (New York: Basic Books, Inc., 1960), p. 21:

> What constitutes a new behavioral technique? It is possible to invent an apparently new technique which, in reality, is no improvement over older methods. This is especially true of new apparatus designs. An editor of a psychological journal once remarked that it was the policy of his journal to publish new techniques, but he stated emphatically that he would never again publish a description of a new tachistoscope. I am certain, however, that he would be happy to publish a new method of utilizing a tachistoscope.

Exaggerating, perhaps, the use of "machine" in education, but proceeding from the same point, i. e., the inadequacy of the term "new media,"[2] Hoban urges us to redirect our attention to educational technology. As he says, ". . . take. . . the concept of educational media. It includes just about everything and almost nothing"[17]. He suggests further that, to make our task more meaningful, we must look for an element which is common to the separate items of hardware identified as educational media. He perceives this common element to be "machines." From that point, he progresses directly to the conclusion that:

> When we consider the part machines play in education, we are forced into a consideration of man-machines systems. When we consider man-machine systems, we are forced into a consideration of technology. By a process of progressive forcing, we advance to the broader concept of educational technology, or technology in education, as a central subject to which we must relate theories, research, and educational practice [17, emphasis added].

From the remainder of Hoban's paper we might infer that educational technology refers only to the complex problems of educational management systems--perhaps to problems no smaller than local school systems. If so, we are indeed "in the wrong ball park" at this Conference. For problems involving such systems, we might have done better to have called upon persons from management, operations research, and systems engineering. From them, we might have learned about things such as cueing theory, simulation techniques, linear programming, theory of games, information theory, and systems dynamics theory. Apparently, some of these concepts have already had a measure of success in solving control and management problems of complex business and industrial systems [10].

---

[2] Hoban uses the phrase "new media" only in the title of his paper. Thereafter he uses "educational media," presumably synonymously.

I would suggest, however, that the problems of educational technology include some simple, even "molecular," problems. Figure 5, below, outlines a simple-to-complex continuum of problems in educational technology. From this point of view, our efforts here have been relevant--particularly with respect to problems at the "molecular" end of the continuum. Consequently, to answer our figurative question, we are in the right ball park!!!

In Figure 5, we begin by pointing out that, just as "machines" constituted the common element which led us to the molar end of the continuum of problems, so we may say here that the peculiar mode of information (i.e., pictorial - verbal) is the common element which leads us to the molecular end. To illustrate, we can (at this end) refer to a history of attempts to direct theoretical formulations towards the effective use of "hardware"!!!

Theory Development

Writing in the Winter, 1953, issue of the Audio-Visual Communication Review, James Finn summarized the inadequate status of theoretical formulation in audio-visual communication [9]. He noted that the basic concept around which nearly all prior formulations were oriented was some notion of a concrete-abstract relationship in learning. This relationship is illustrated in Figure 6, following, by the familiar "cone of experience."[3] Finn emphasizes, however, that the cone is to be considered as being no more than a "visual metaphor" for his text on audio-visual methods and the use of audio-visual materials[9].

Under the impetus of military training research funds, more systematic approaches to the construction of recognizable theory were undertaken by Smith and Van Ormer [31], Kendler, Kendler and Cook[20], and J.J. Gibson[12].

The Smith and Van Ormer report entitled, "Learning Theory and Instructional Film Research," was frankly oriented

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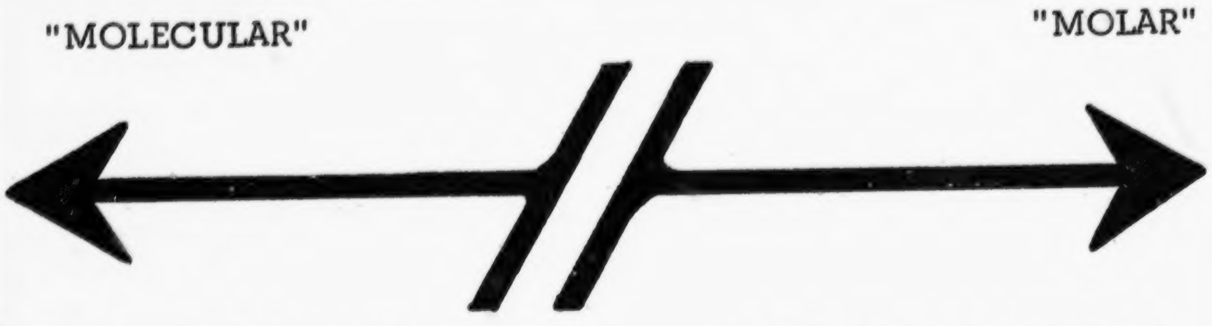
[3] The "cone of experience" was popularized by Edgar Dale in Audio-Visual Methods in Teaching [3].



Mode of Information

Man-Machine Systems

the nonsense syllable
the nonsense figure

the "meaningful" word
the "meaningful" picture

the pupil-teacher system
the pupil-"teaching machine" system

the teacher-language laboratory system
the teacher-electronic classroom system

mass educational systems:
state, interstate, national,
and international television

Figure 5.--Molecular-Molar Continuum of Problems of Educational Technology.

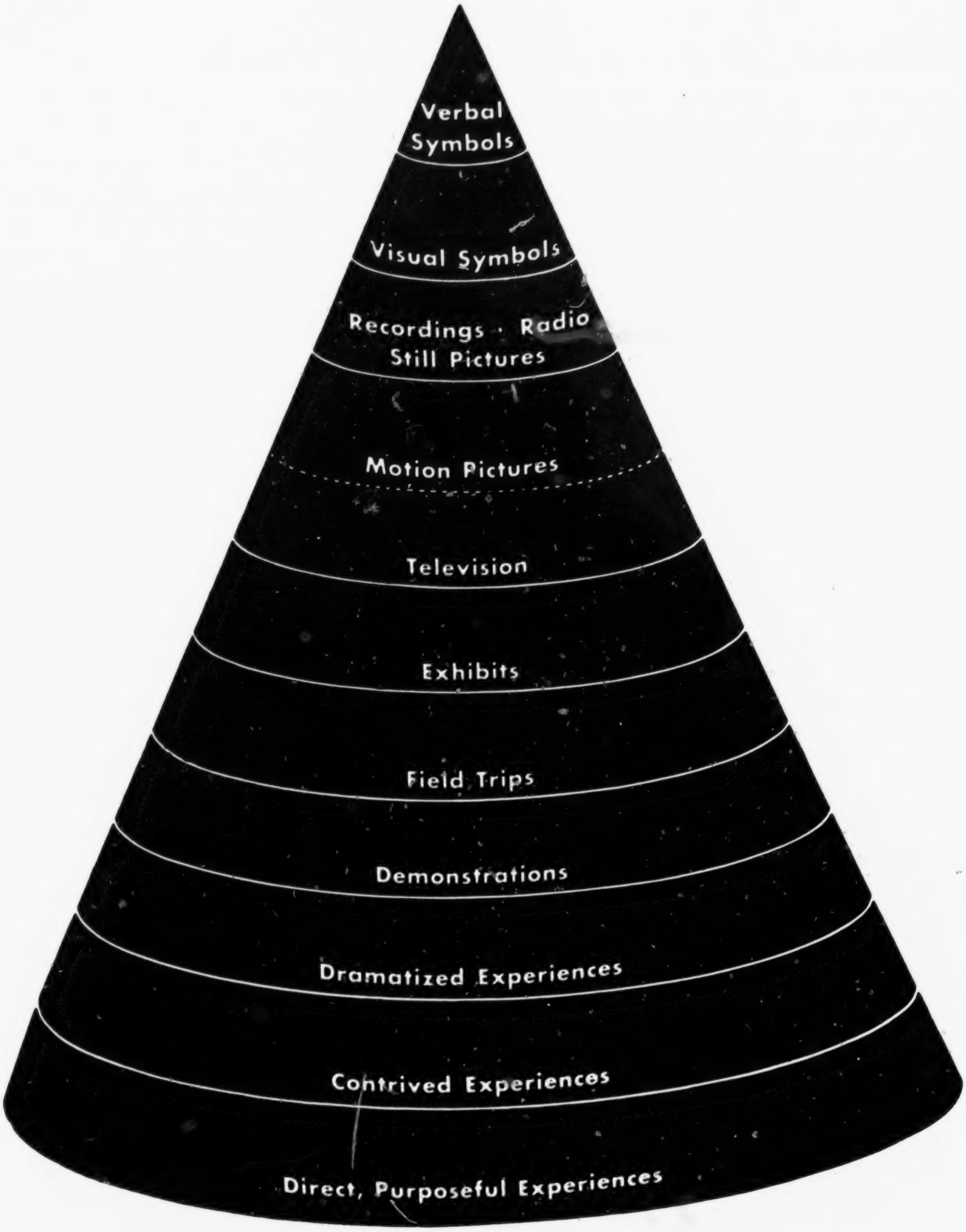

Verbal Symbols
Visual Symbols
Recordings · Radio
Still Pictures
Motion Pictures
Television
Exhibits
Field Trips
Demonstrations
Dramatized Experiences
Contrived Experiences
Direct, Purposeful Experiences

Figure 6.--The "Cone of Experience": Illustration of the Concrete-to-Abstract Relationship in Learning.

toward the film research program at Pennsylvania State University. The work was sponsored by the United States Naval Training Devices Center and directed by Dr. Ray Carpenter. Smith and Van Ormer presented their theory in the form of isolated statements of principles--such as, "The learner must feel an urge (desire, drive, need, tension) to learn certain things if there is to be much learning" [31].

The work of Kendler, Kendler, and Cook attempted to relate implications of modern learning theory to audio-visual training, and to develop testable hypotheses--with the idea of mapping the field in terms of an integrated research program. The title of their formal report was, "Implications of Learning Theory for the Design of Audio-Visual Aids"[20]. The project was sponsored by the United States Army.

Kendler, Kendler, and Cook's report [20] was based upon stimulus-response reinforcement theory as expounded by Miller and Dollard [25]. The organization of the report followed the four factors of Miller and Dollard, namely, drive, cue, response, and reward. Under the heading "cue," for example, the author's were primarily concerned with stimulus generalization, stimulus patterning, and task characteristics. They illustrated these processes by sample problems [20]:

1. What sequence of highly delineated, normally delineated, and poorly delineated camouflaged areas is the best method of teaching fine discrimination?

2. Do training films with battle sounds give better results than films without battle sounds?

3. Will the introduction of the rhythmic characteristics of the task serve as a cue to facilitate learning?

Perhaps the most fundamental approach to theory construction is (visual) communication was undertaken by J. J. Gibson for the Air Force. The project was justified on the grounds that:

> A satisfactory theory comprehending the basic psychological factors governing the perception of pictorial materials is a prerequisite to effective long-range programs of

> research directed toward a better understanding and prediction of the advantages of audio-visual training materials [12, p. 3].

In his report Gibson elaborates on the view that, central to a theory directed toward and understanding of audio-visual training materials, is an understanding of the differences between words and pictures. Furthermore, he suggests that there may even be two kinds of thinking such that:

> It is not unreasonable to suppose that a person can learn to think in terms of drawings, or graphs, or models. . . as well as in terms of words. It may even be possible to infer. . . that, in certain respects, such thinking is more easily performed than is verbal thinking [12, p. 10].

In 1957, Neal Miller answered the call of the media. His efforts [23] resulted in a statement of "Scientific Principles for Maximum Learning from Motion Pictures." It is not surprising that, at this (molecular) end of our continuum (see Figure 5, above), the type of research called for is somewhat different from that described at the molar end. Thus we find that Miller says:

> We believe that the greatest advances in graphic communication are likely to come from basic research of a theoretical-analytical type at the pure science level. Completely empirical comparisons of different media in a given situation can yield results which are largely an artifact of unspecified characteristics of the particular representative of the media which the experimenter happens to use. Such results tell us little about the inherent properties of different means of representation. A better theoretical analysis of how people learn from pictures and words will help us to design more discriminative experiments[24, pp. 61-62].

Illustrative Studies

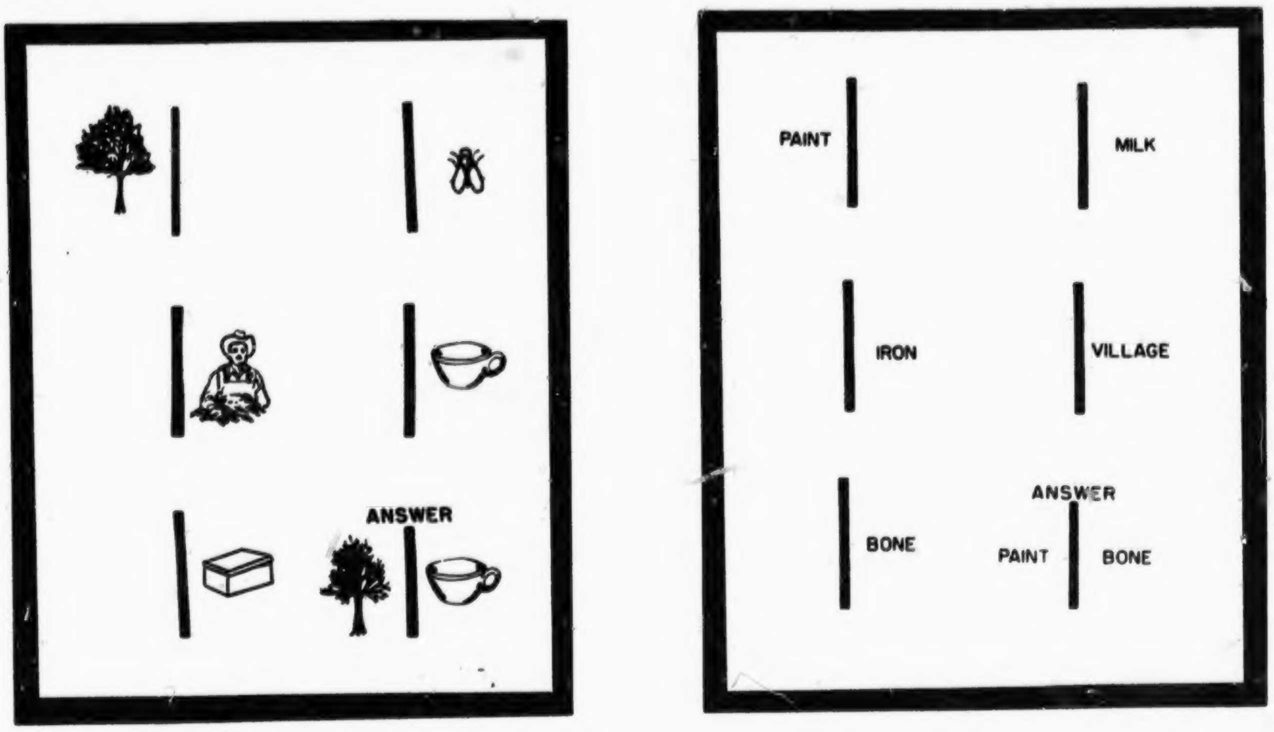
Most of the significant aspects of theory development which have been discussed can be illustrated by referring to research on the processes of communication and education. In this section, several studies are summarized. Examples of their experimental materials are shown. The specific purpose is to illustrate research on molecular problems of educational technology.

Verbal-Pictorial Problem.--We can cite the doctoral study of A.A. Lumsdaine [22] as an example of concern with the verbal-pictorial problem noted by Miller. This study was designed to compare "ease of learning" as a function of mode of stimulus material i.e., verbal or pictorial modes. The experimental variables consisted of pictures and words presented in four combinations of paired associates. The major conclusions of the study were that: (1) as stimulus terms, pictures are better than printed words naming the object, and (2) as response terms, printed words are better than pictures.

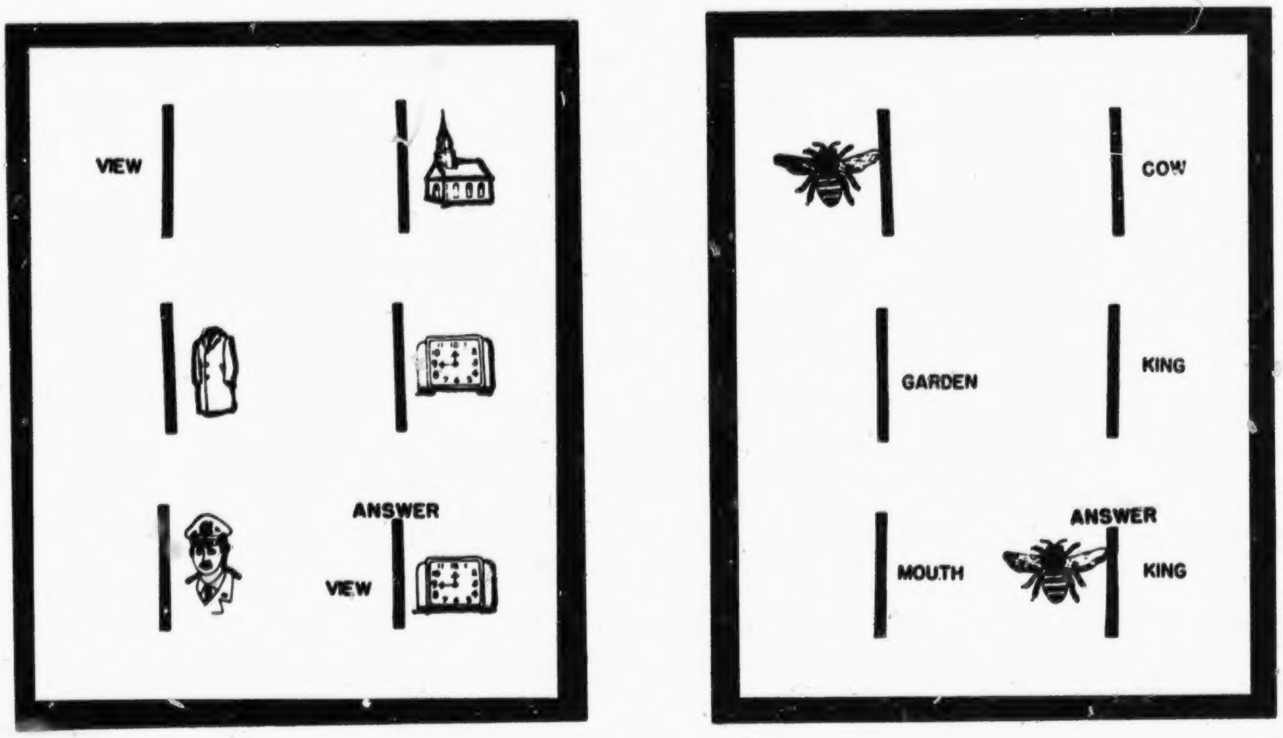
In the Lumsdaine experiment, the subjects were required to make a verbal response to a supposed pictorial response term. In effect, they were required to learn additional verbal associations for pictorial response terms. Bern [1] attempted to overcome this artifact by requiring recognition rather than recall responses. That is, he presented examples of his word-picture pairs in a way which did not require verbal responses to pictured terms. Examples of his experimental materials are shown in Figure 7, on the following page.

Strategy and Verbal Response.--A study by M. Fleming [11] provides another illustration of an attack on a molecular problem of educational technology. Fleming was concerned with the problem of controlling verbal responses to pictorial stimuli: "What communication strategy (general procedure for manipulating pictorial attributes) will increase the predictability of the receiver's verbal response?" Examples of his hypotheses and associated strategies are given below:

> Hypothesis I: The concrete-to-abstract level of verbal response to one pictured object will vary inversely with the overall number of attributes employed.
>
> Strategy I: Examples of the stimuli which represent Strategy I are given in Figure 8, below. As indicated under Hypothesis I, Strategy I is concerned with manipulating the (total) number of pictorial attributes.


ANSWER
PAINT
MILK
IRON
VILLAGE
BONE
ANSWER
PAINT
BONE

Picture-Picture **Word-Word**


VIEW
ANSWER
VIEW
COW
GARDEN
KING
MOUTH
ANSWER
KING

Word-Picture **Picture-Word**

Figure 7.--Word and Picture Materials Arranged for Recognition Responses.

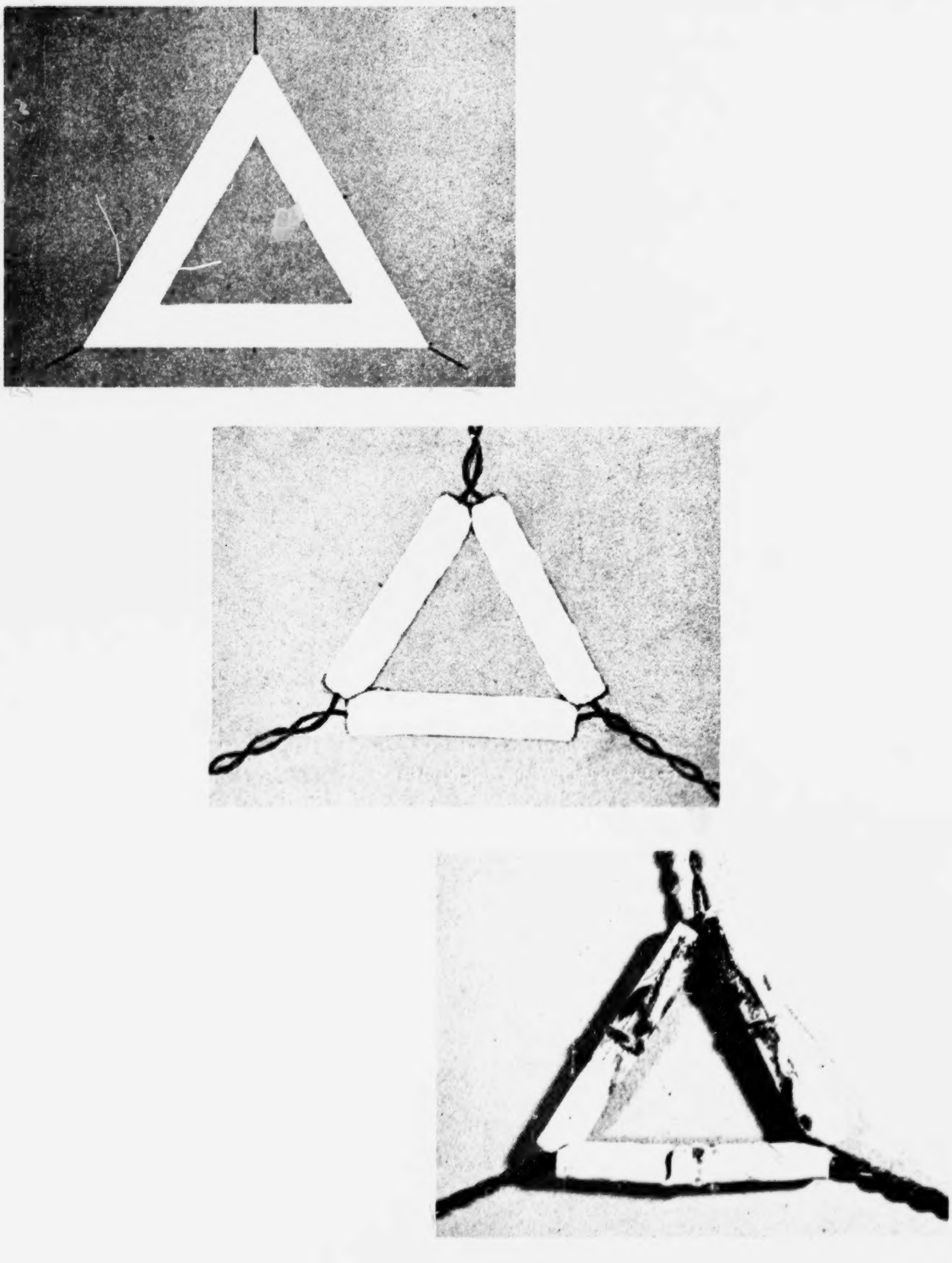


Figure 8.--One of the Series of Stimuli Representing Strategy I: The Manipulation of the Over-all Number of Pictorial Attributes.

Hypothesis II: The concrete-to-abstract level of verbal response made to two pictured objects will vary inversely with the number of attributes which are similar in both objects.

Strategy II: Figure 9, following, pictures one of the series of stimuli representing Strategy II. This strategy is concerned with the manipulation of pictorial attributes common to both members of a pair of figures.

Responses to Pictorial Messages. --H. Black [2] also studied responses to pictorial messages, but he chose nonsense figures as his messages. He described the central concern of his study as follows:

> The programmer of a pictorial sequence for a learning machine, a film strip, or a motion picture, is faced with the same general questions as the theoretician who would explain perceptual learning. These questions are, generally: (1) What are the ways in which pictorial materials can be varied physically to increase desired responses? and, (2) How do variations in the presentation of a pictorial message effect responses to later messages [2, p. 12]?

Black used the "nonsense" illustrations presented in Figure 10, below. His specific purpose was to determine the effects on response of three conditions: (1) prior experience with the same, similar, or different figures; (2) addition to the figures of lines which were relevant, that is, lines which were correlated with the reinforcement contingency; and (3) addition to the figures of lines which were irrelevant, that is, lines which were not correlated with the reinforcement contingency.

Summary: Reducing the Difference-Signal

The studies which have been briefly described, with major emphasis on purpose and design, are offered as examples of application-oriented theoretical research at the molecular level of educational technology. It would, of course, have been possible to deal with experiments at other points of the molecular-molar

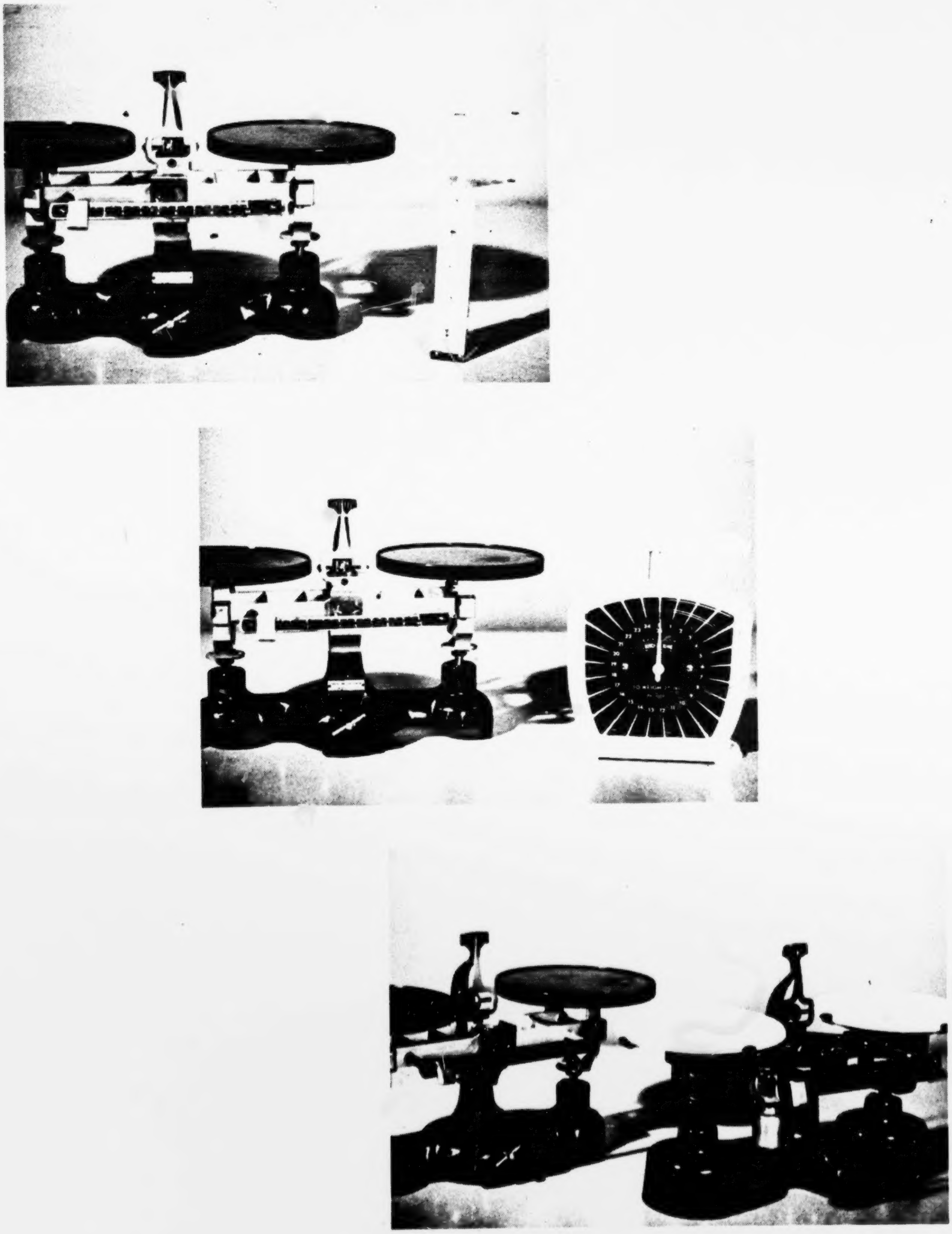
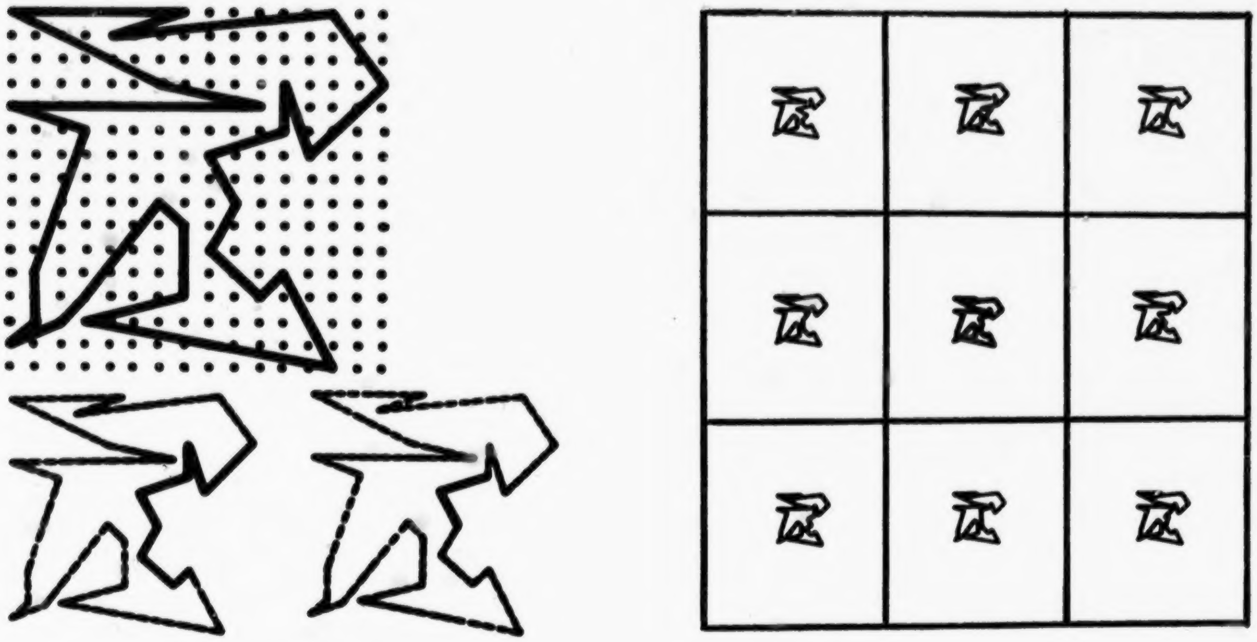
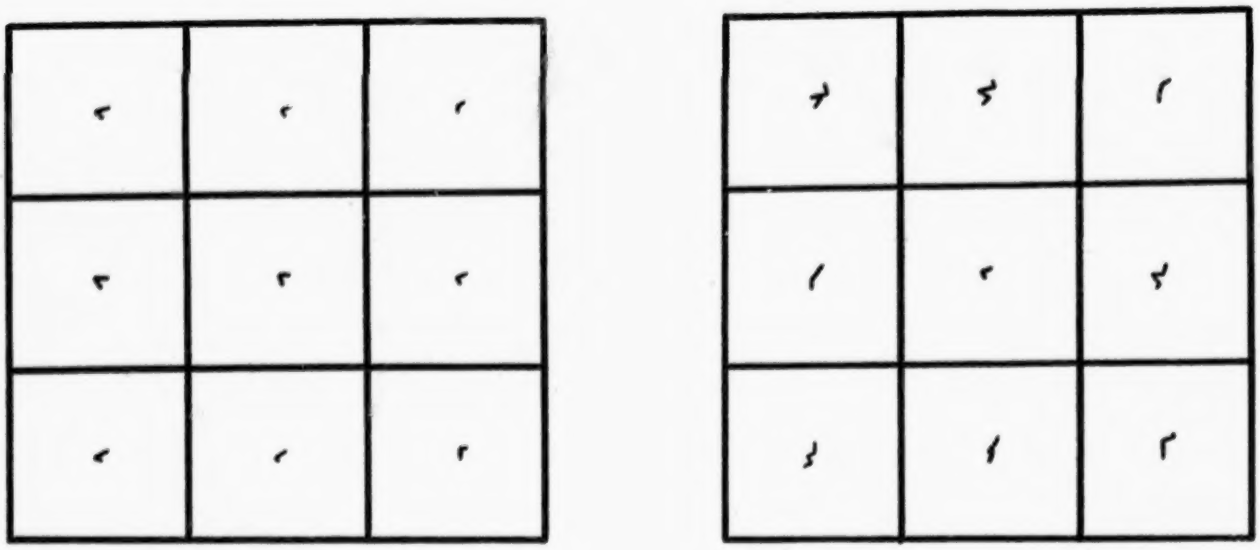


Figure 9.--One of the Series of Stimuli Representing Strategy II: The Manipulation of Pictorial Attributes Common to the Members of a Pair of Figures.



A. Design of 27, 9, and 3 Point Prototype Figures. (Broken lines and dots were deleted from the stimulus used in the study.)

B. Twenty-Seven Point Prototype (center) and Eight Variations Made by Varying the Location of One Point.



C. Three Point Prototype (center) with Eight Variations Made by Varying the Location of One Point.

D. Three Point Prototype (center) with Eight Variations Made by Varying the Location of Three Points.

Figure 10.--Nonsense Figures Used to Study Responses to Physical Variations in Visual Stimuli.

continuum--for example, the interstate system of television broadcasts from an airplane (Midwest Program on Airborne Television Instruction).

To summarize briefly, I have expounded on three themes:

1. I have said that the new media component of the difference-signal, identified and defined at the beginning of this presentation, may be reduced by re-defining "new media" to include a concern with a continuum of learning problems. This continuum ranges from a molecular pole at which, for example, the concern might be with specific (narrowly-defined) problems of learning; to a molar pole at which problems of international systems of learning would be more typical.

2. I have also reviewed the kind of scientific theory which has been used in operations undertaken at the molar end of the molecular-molar continuum.[4]

3. Finally, I have described and illustrated elements of the history and nature of theoretically-oriented research at the molecular end of the problems-of-educational-technology continuum.

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[4] As we have seen, some of the historical roots of molecular, theory-oriented research were developed at the specific behest of "media" persons whose orientation, on the whole, was toward the "pictorial" rather than toward the "verbal" mode of the media. A rapidly-growing "root," some would say that it is a "flower," which originated independently, is now developing. This "root" is oriented primarily toward the verbal mode of the media [14]. The story of this development is too lengthy to be elaborated upon at this time. . . .

The Integration Component

Second Task

Having disposed, after a fashion, of the new media component of our difference-signal, we come to the more difficult task of reducing the integration component of our difference-signal. Integration always seems to encompass terrible difficulties--whether in mathematics, politics, or at conferences. It is never brought about, however, by avoiding the implied challenge of the underlying problem. . . .

Hoban [17] suggests that the man for this job is the "pandemic" man. In the absence of aspirants for the role of "pandemic" man, and at the risk of putting one foot into the "logodemic" area, the other into the "practidemic" area--and the third into my mouth, I shall now assay that role. I hope that the result will not be pandemonium!!!

Criteria for Analyzing Theories

You will recall that I proposed to attack the problem of reducing the integration component of our difference-signal by developing an instrument for integration. More specifically, this instrument for integration was to be a "checklist" of criteria to use in examining our theories.

In pursuit of this end, I shall begin by examining some of the working papers prepared for this Conference. My specific purpose shall be to discover what they might suggest, directly or indirectly, in the way of possible criteria. Please note that my search shall be highly selective. Time, audience considerations, and prudence preclude other alternatives. . . .

Structure and Function of Theories

Professor Rudner said that he saw two alternative ways of presenting his paper. He chose a third--the wrong way in my opinion. I wish that he had taken the alternative of trying to "insult us" by presenting his results ". . . in such elementary step-by-step fashion that none of them, nor the jargon used to describe them, would seem in the least mysterious. . ." [29, p. 1]. If he had attempted to do so, he would have reduced our problem of integration. In addition, he would have discovered that it is not easy to insult people by speaking simply.

More importantly, perhaps, he would have come face to face with a central problem of the "new media," namely, the problem of programming. He would have appreciated why the new multi-million dollar teaching machine industry is beating the bushes for programers. He would have discovered that, in addition to thorough familiarity with the subject, a programer requires the perseverance of B. F. Skinner's pigeons, the free time of a retired banker, hundreds of experimental subjects of the caliber of the participants in this Conference, etc., etc. In fact, it is probable that he would have felt very soon a need for advice from a new media expert in teaching machines--that is, a man who had presumably succeeded in insulting somebody!! At any rate, we were not insulted. Consequently, being on speaking terms with Dr. Rudner, we can feel free to ask a few questions.

In the preceding discussion of the term "new media," we concluded that the major concern of this Conference was the use of theory in making more effective uses of the media. Surely an understanding of the structure and function of theory, especially the function of theory, should provide us with criteria for our checklist.

Indeed, in the section of Dr. Rudner's paper entitled, "The Uses of Theories," we find two readily recognizable criteria [29, pp. 29-31]. In this section we learn that the two most important functions of theories are: (1) explanation, and (2) prediction. If we knew what these terms meant, and if we could specify the "new media" events we wanted explained and/or predicted, we could presumably evaluate the theories presented by Professors Logan, Bettinghaus, and Janowitz--according to their power to explain and/or to predict relevant, specified events.

Would it be reasonable for theoreticians, given these criteria, to undertake such a task? We are not, of course, going to ask them to do so at this Conference--if only because we have not even met the prior requirement of specifying the "events" implied by the term, "new media." Instead, we shall continue to fashion our checklist of criteria for evaluating theories--perhaps for the next conference on new media theory!! We may even find other theoreticians who are willing to supply us with use-oriented criteria! Do you doubt it???

Criteria from Learning Theories

Consider, for example, the criteria for theory evaluation offered by the authors of Modern Learning Theory [8]. For their own appraisal of five major learning theories, these theoreticians used formal, extensive, and morphologically sophisticated criteria. However, they recognized that:

> Scientific theories are evaluated, not on some absolute scale of "theoryness," but with respect to what we expect them to do. Some of the functions of a useful theory are: (1) clarifying the description of the world possible in ordinary language [clarification], (2) summarizing existing knowledge [summarization], (3) mediating applications of our knowledge to new situations [mediation]. (4) leading to fruitful lines of experimental inquiry [experimentation] [8, p. xv].

We will not stop now to elaborate upon these criteria. Our primary task is to compile a sample of criteria for future consideration. Later, however, I shall illustrate how these authors elaborated upon the criteria they proposed. Meanwhile, we can add to our list of criteria: "clarification," "summarization," "mediation," and "experimentation."

Criteria from Models

In order to extend the range of sources of criteria, I suggest that we include criteria which refer to models--as well as criteria which refer to theories. Both Professor Rudner and Professor Bettinghaus have already provided a basis for this extension.

Professor Rudner discussed the formal relationships between theory and model--recognizing that both terms were used broadly. Professor Bettinghaus recognized the formal requirements for a model, but he indicated and demonstrated the need for being satisfied with less rigorous usage. The foregoing qualifications lead to a provocative question, "How loosely can a model be defined and still be useful?"

An interesting answer to questions of "use" is provided by the philosopher, K. Deutsch. He says that:

> Whenever men try to understand a complex process, they do so by seeking a model. The model may be a physical, three-dimensional structure, or a set of graphic notations, but. . . without models, explicit or implicit, there is no understanding [5, p. 185].

We might even say that, whenever we communicate, whenever we seek to explain something, we do so in terms of models--explicit or implicit. Thus, at the most elementary level, a single word or a group of words implying a simile, can be considered to be a model. In Operational Philosophy [28], A. Rapoport develops this idea delightfully in the chapter, "Metaphors and Models." In a parallel vein, "like father, like son" may be considered to be a pre-scientific observation of the laws of heredity. Similarly, "war is hell," may still be the best "model" available for "explaining" the qualitative aspects of war.

In Hoban's observation, "Knowledge. . . that is sought without committed interest in application. . . is very much like salvation by faith without good works" [17, p. 23], we can recognize a model which is intimately related to a most elaborate, intellectual "theory." If we accept and extend this line of reasoning, we shall discover that we have always been "speaking in models" without knowing it--in much the same way as Monsieur Jourdain discovered that, without knowing it, he had been speaking in prose all his life!!!

Having made our Conference task more difficult by increasing the potential sources of models, Deutsch compensates by suggesting several additional criteria for evaluating models. We can abstract them from his discussion [6] of the functions of models:

1. The organizing function: to provide a structure to something less known in terms of the structure of something presumed to be better known, or more tangible.

2. The heuristic function: to provide a path to the discovery of new perspectives, new approaches, new insights--perhaps at a level no higher than analogy.

3. The mensurative function: to provide a means for quantifying that which, hitherto, has been only qualitative.

Elaborating Evaluative Criteria

Dr. Rudner's paper, and the excursions which it stimulated, has provided us with a fair beginning in developing our checklist of evaluative criteria. We shall therefore proceed to Dr. Logan's paper. . . .

Before moving on, however, we should note that the criteria which have been identified up to this point will require considerable clarification and specification before they can be applied. To examine even one of the theories presented at this Conference, in the systematic fashion implied by our growing checklist of criteria, would require much more time than we have available.

Turning now to Dr. Logan's paper, I should like to use it as a basis for two lines of development: (1) to illustrate how criteria for the evaluation of theories might be elaborated, and (2) to suggest a criterion for pre-selecting theories prior to making a detailed evaluation of them.

One example of more elaborate specification for the comparative evaluation of theories is presented in Modern Learning Theory [8] which has already been cited. This textbook attempts a comparative evaluation of the learning theories of Hull, Tolman, Skinner, Lewin, and Buthrie. The dimensions which the authors of the textbook considered to be fundamental in evaluating the structure and content of a theory are outlined in Figure 11, below--and on the pages following.

Figure 11.--Suggested Dimensions for Reviewing and Evaluating Theories. Adapted from Modern Learning Theory [8, pp. xiii-xiv].

I. STRUCTURE OF THE THEORY:

A. Delineation of empirical area:

1. Data language:

   Is the data language explicit and theoretically neutral?
   How does the theorist relate his empirical variables to the data language?

2. Dependent and independent variables:

   How does the selection of variables compare with that of other learning theories?
   What influence does the choice of variables exert on the form of the theory?

3. Relation between empirical areas covered and the orientative attitudes exhibited by the theorist.

B. Theoretical concepts:

1. Primitive terms:

   Are the primitive terms of the theory reducible to physical or object language?
   Is the usage of primitive terms fixed by implicit or explicit definitions?

(Continued)

Figure 11--Continued:

2. Principal constructs:

   Do these serve only a summarizing function or are they related by definition or by hypothesis to terms of other disciplines?

3. Relations assumed among constructs:

   How are the major theoretical variables interrelated in the fundamental assumptions of the theory?
   How are such interrelations constructed from the observation base of the theory?

4. Relations assumed or derived between constructs and experimentally defined variables.

II. METHODOLOGICAL CHARACTERISTICS:

A. Standing of the theory on principal methodological "dimensions":

1. Explicit axiomatization.

2. Quantitativeness.

3. Consistency and independence of principal theoretical assumptions.

4. Use of physical or mathematical models.

B. Techniques of derivation:

1. Are the empirical consequences of the theory developed by informal argument or by formal derivations?

(Continued)

Figure 11--Continued

III. EMPIRICAL CONTENT AND ADEQUACY:

A. Range of data for which interpretation or explanation in terms of the theory has been claimed.

B. Specificity of prediction demonstrated.

C. Obvious failures to handle facts in Area III-A.

D. Tours-de-force:

1. Has it been possible to predict new experimental phenomena?
2. Have any predictions of this sort been confirmed?
3. Does the theory account for facts which are not predictable from competing theories in the same area?

E. Sensitivity to empirical evidence.

F. Programmaticity.

G. Special virtues or limitations--techniques which may prove useful outside the context of the specific theory.

It is quite apparent that the outline in Figure 11 is concerned with more formal theories than those presented by Dr. Bettinghaus and Dr. Janowitz. However, the outline might perhaps, be applied more appropriately to Dr. Logan's theory. His theory is closely related to that of Clark Hull. We might, therefore, profit from reviewing the evaluation of Hull's theory in Modern Learning Theory [8], and then perhaps, estimate how Logan's theory would fare. One consequence of the suggested review exercise might be an examination of other theories of learning--as Professor Logan suggests. Appropriate sources might be the overview of theories of learning provided by Hilgard

[16], or the more comprehensive summary and analysis given by Koch [21].

In Koch's book [21], we would find a chapter written by Professor Logan on the Hull and Spence theories. It would undoubtedly shed light on the paper which he has presented to us. Hilgard [15] makes the following comment about this chapter:

> The Hull-Spencer chapter by Logan is an excellent one, pointing up the similarities and differences between Hull and Spence, and modestly introducing Logan's own conception of the micromolar level of analysis. This new outlook, which Logan is developing as his contribution to learning theory, suggests that responses of different force, rate, or intensity, are different responses, and the learning of which of these responses to give is an important determiner of the course of learning. The emphasis is, in fact, a natural extension of the distinction that Skinner has made all along between discrimination of stimuli and differentiation of responses. Logan announced his position in 1956, but he has been developing it since, and we expect to hear more from him [15, p. 21].

I mention this item, not only to impress you with the privilege of having Professor Logan with us, but also to point out that he has been working on his paper for six years rather than for six months--as previously stated.

From Theory to Research and Practice

In Koch's book [21], we might also wish to examine the chapter by Neal E. Miller entitled, "Liberalization of Basic SR Concepts" [21, pp. 196-292]. Although it is written in the SR framework or Hull (and Logan), it extends that framework to conflict behavior, motivation, and social learning. It is of particular importance to us for two reasons. The first reason is its direct theoretical relationship to Miller's "Scientific Principles for Maximum Learning from Motion Pictures" [23, pp. 61-113], which was cited in our discussion of the historical roots of educational technology. The second reason is its illustration of how one may proceed from a formal theoretical structure to implications for research and practice. His concept of "drive," for example, "liberalized" for problems of instructional films, yields hypotheses which Miller suggests as examples of the type which should be investigated:

> 1. The motivational effects of a film are dependent upon the learned drives which the viewer already possesses. . . .
>
> 2. The motivation aroused by films must be reinforced in daily life. . . .
>
> 3. Whenever the conditions of life are different for different audiences, their motivations will be expected to vary. . . .
>
> 4. One way of arousing a motivation for a given action is to show that it is a means to a goal that the subject is already motivated to achieve, or a way of avoiding a consequence that the subject is already motivated to avoid.
>
> 5. It is more difficult to motivate people when the reward or punishment for action will be delayed. . . .
>
> 6. The motivational effect of a communication tends to dissipate with time; if possible, it is best to apply your motivational stimulus immediately before you want to get action.
>
> 7. Motivation and attitudes can be conditioned and deconditioned. . . .
>
> 8. Repetition is needed but experimental extinction (negative adaption or boredom) must be avoided. . . .
>
> 9. The summation of a variety of different compatible motives should be more effective than any one of them taken alone. . . .
>
> 10. Some motivations and attitudes are much harder to change than others. . . .
>
> 11. For the factual informational type of film, the intent of the producer should be made clear to the audience, but

> for a propaganda-type film to have the greatest effect, the intent of the producer should be concealed.
>
> 12. Identification with the hero facilitates adopting his motives and attitudes. . . .
>
> 13. Whenever fear is used as a motive, it is important to point out very clearly the appropriate ways of avoiding the danger and escaping the fear [23, pp. 66-69]. . . .

With some justification, perhaps, we might question the nature of these "hypotheses" and their relation to formal theory. However, we must admit that, at least, they do provide us with a starting point.

Communication and Social Theory

We can summarize our progress in developing a checklist of criteria for evaluating theories by noting that Professor Logan's paper has provided a point of departure for: (a) indicating how the criteria might be elaborated, and (b) suggesting that, before applying these criteria, one might (within any given type of theory, such as SR) pre-select those theories which have already "liberalized" their basic concepts so as to enable one to make extensions in the direction of "applications."

If, in considering the two remaining Conference papers, we should like to benefit from the foregoing discussion, we should (1) pre-select from our population of communication and social theories according to the principle of "liberalization" of formal concepts, and (2) examine the theories selected in terms of the checklist of criteria which have been developed.

Criterion of Common Elements.--Professor Bettinghaus seems to have anticipated the first recommendation. You will recall that he described several communication models, and then presented a communications-related, "liberalized" theory: Balance Theory. His exposition, however, suggests additional criteria for our checklist--and provides me with an opportunity for pointing to the serious purpose underlying my use of the term "difference-signal."

After abandoning communication theory, per se, Professor Bettinghaus developed a set of characteristics common to congruity theory, cognitive balance theory, strain-toward-symmetry theory, and homeostatic theory. He then called this common set of characteristics "Balance Theory." This procedure suggests yet another criterion, related to the laws of Parsimony and Efficiency, namely a criterion which might be called the criterion of "commonality." Briefly, it states: "That model is most useful which can be shown to possess the greatest number of characteristics common to the greatest number of related models."

To extrapolate, if there exists a set of characteristics common not only all balance theory models, but to many of the other communication models presented to us, only a label would be needed to warrant our evaluation of it as a model or theory. Such a label does, in fact exist--together with the referent model, and the theory from which the model is derived! I have used the term, "difference-signal," as a temporary disguise for the label--in order to build up the suspense. A pictorial representation of the referent model is given in Figure 12, below.

The basic "servo" model is presented in Figure 12. This same model, in less recognizable and more liberalized pictorial representations, is given in Figures 13 and 14, following. Compare Figures 12, 13, and 14 and note the common elements: "input," "output," "difference (or error) signal" and, most common of all, "feedback."

And what is the significance of the "servo-model"? According to some people, it is nothing less than the physical symbol of the thought of our age. It has been said that the thought of each age is reflected in its technique and that the present age is as much the age of the servo-mechanism as the 19th century was the age of the steam engine. The theory associated with the "servo-model" is drawn from cybernetics [13, 33]. I am not going to demonstrate here that cybernetic theory is the source of most pf tje "process" models discussed by Dr. Bettinghaus. At this time, I merely wish to point to another criterion for our checklist, "commonality."

Before leaving this point, however, we might note that the criterion of commonality implies both intra-disciplinary and

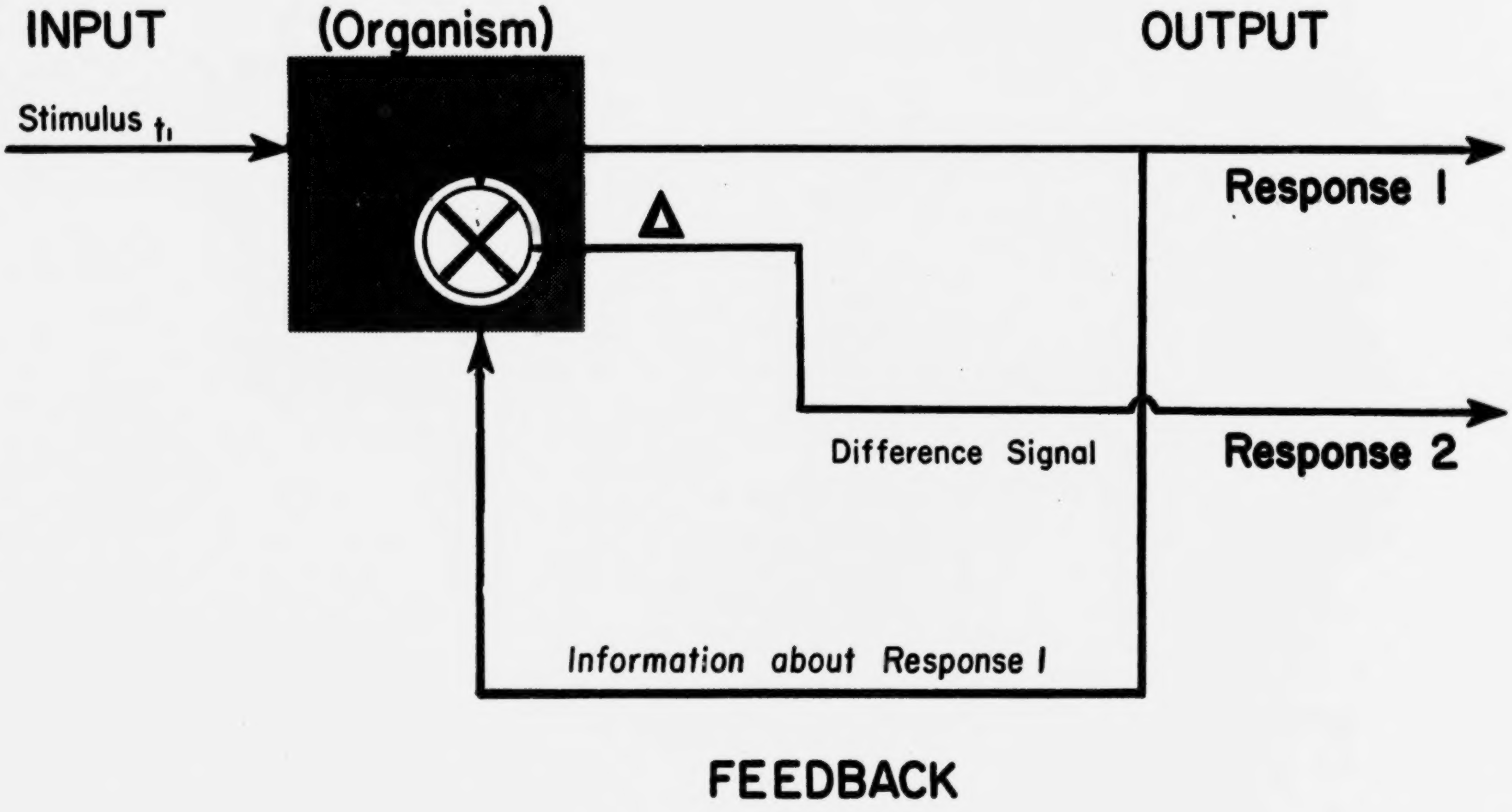
INPUT
(Organism)
OUTPUT
Stimulus t1
Δ
Response 1
Response 2
Difference Signal
Information about Response 1
FEEDBACK

Figure 12.--Basic Servo-Model Signal.

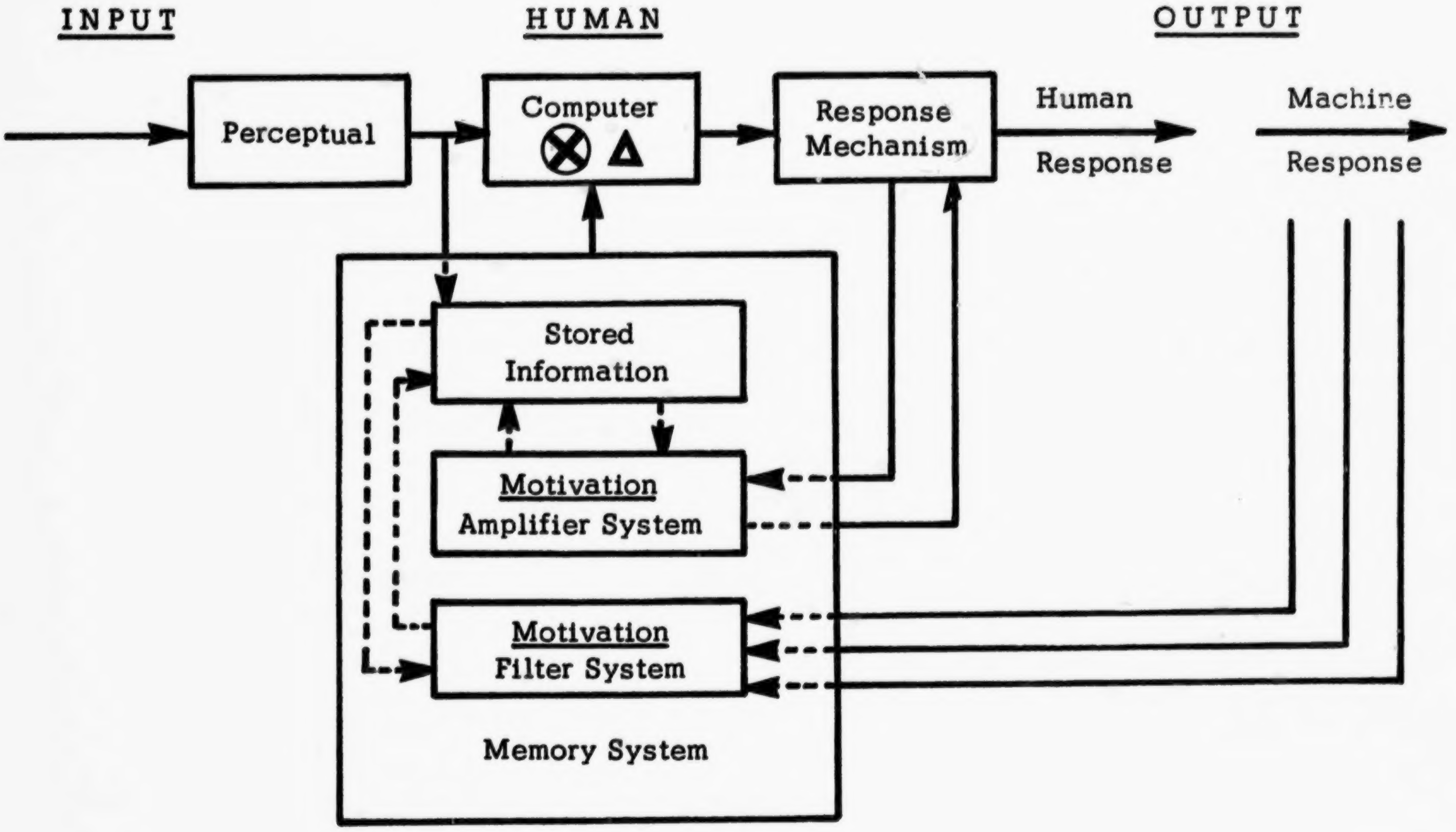
INPUT
HUMAN
OUTPUT
Perceptual
Computer
⊗ Δ
Response Mechanism
Human Response
Machine Response
Stored Information
Motivation Amplifier System
Motivation Filter System
Memory System

Figure 13.--Motivation as a Servo-System. Adapted from R. B. Miller, "Psychological Considerations in the Design of Training Equipment" [24].

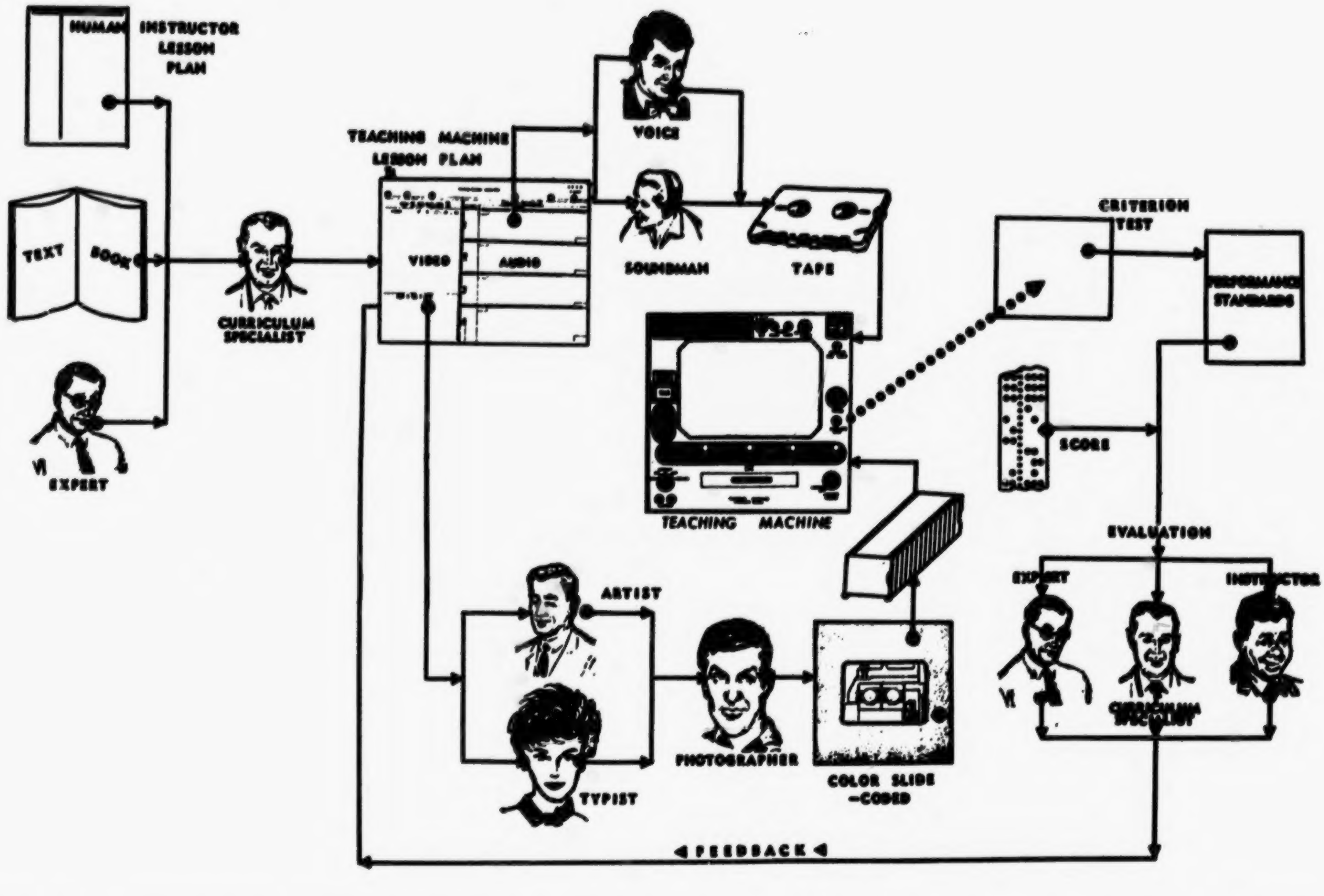
HUMAN INSTRUCTOR LESSON PLAN
TEXT BOOK
EXPERT
CURRICULUM SPECIALIST
TEACHING MACHINE LESSON PLAN
VIDEO
AUDIO
VOICE
SOUNDMAN
TAPE
CRITERION TEST
PERFORMANCE STANDARDS
SCORE
TEACHING MACHINE
EVALUATION
EXPERT
CURRICULUM SPECIALIST
INSTRUCTOR
ARTIST
TYPIST
PHOTOGRAPHER
COLOR SLIDE —CODED
◄FEEDBACK◄

Figure 14.--Curriculum Development as a Servo-System. Adapted from L. D. Silvern, "Specifications for a Component-Type General Purpose Teaching Machine--for Curriculum Development" [30].

inter-disciplinary facilitation of communication. The latter aspect might be regarded as a separate criterion. In this connection, note that the origin and the raison d'etre of cybernetics is interdisciplinary [33].

Criterion of Time and Place.--Related to the observation that the thought of each age is reflected in its technique, is still another criterion for our checklist. This criterion might be called "modernity" or "contemporaneity." It does not imply mere "fashionability." It implies the difference in the power of conceptualization between one era and another. This difference is a function of increased knowledge and experience. For example, such a difference is indexed by the thought models available to a bow-and-arrow civilization and to a space-missile civilization such as ours.

The "contemporaneity" criterion is also suggested by K. Deutsch's description of the development of three major types of thought models: models concerned with a mechanism, models concerned with an organism, and models concerned with process [6]. During the later middle ages, the increasing familiarity with mechanism as a model of thought resulted, for example, in an explanation of the solar system as a "clock work." Similarly, the resultant of power relationships among nations was called "a balance of power," and the distribution of governmental powers in the United States was termed an arrangement of "checks and balances."

The obvious limitation of the mechanical model resulted in the development of the "organismic model." This model postulated an elan vital which was forever unanalyzable. For about one hundred and fifty years, this type of model served a useful purpose in areas such as biology and educational psychology. It permitted a larger perspective of problems in terms of interdependence and growth. However, the limitations of the organismic model led, in turn, to the development of a third group of models. This group included many features of earlier models. However, these newer models gave primary emphasis to the notion of "process," that is, to the notion of an interplay of changes. With this type of model, processes such as learning and goal seeking, which might be said to be beyond the expository capacity of any mechanically structured SR theory, can be explained without recourse to "vitalistic" concepts. Before dismissing this observation, we might consider the fact that a well-known psychologist, H.O. Mowrer, is restating his basic thinking in learning theory, language, and personality in terms of cybernetic theory [26].

Criteria from Social Theory.--For several reasons, I shall not attempt to identify evaluative criteria in Dr. Janowitz's paper on social theory: (1) I did not have enough time to work on it, (2) it seems likely that many of the criteria already established will be repeated in it, and (3) from skimming his paper and from listening to his presentation yesterday, I gather that, at this moment, Dr. Janowitz is really plugging for no theory at all!

Summary: Checklist of Criteria

To review briefly, we set out to reduce the integration component of our difference-signal by developing (and applying) an "instrument for integration." This instrument, was to take the form of a checklist of criteria for use in evaluating theories and theoretical models. These criteria were to be abstracted from the Conference working papers and from other promising sources.

Having completed a quick survey of some of these sources, we now have a dozen criteria: (1) explanation, (2) prediction, (3) clarification, (4) summarization, (5) mediation, (6) experimentation, (7) organization, (8) exploration [discovery], (9) mensuration, (10) commonality [parsimony], (11) interdisciplinarity, and (12) contemporaneity. Undoubtedly, the criteria overlap and are subject to reduction in number. I submit, however, that they can serve as a logical instrument for the "integration" purposes of conferences such as ours.

Analyzing Conference Assumptions

A Basic Assumption

A logical extension of our concern with scientific theory suggests that it might be profitable to examine a basic assumption underlying this Conference. Can theory make a significant contribution to planning and conducting research, and to the application of research findings, in the technology of education? ? ?

Application of Learning Theory

In the final chapter of his book, Theories of Learning [16], Hilgard comments on the problems of applying theory. He begins by posing a question, and then proceeds to develop an optimistic and authoritative answer:

> How can psychologists be helpful to other social scientists or to those who wish to apply their findings if they disagree among themselves on these fundamental matters? It seems to us that there are several considerations which temper this adverse judgment. For one thing, there is a great deal of empirical knowledge about learning which is unrelated to the differences among the major points of view. For another, there are, in addition to the general theories, a number of special theories, more closely related to particular experimental situations. These special theories, are tested and corrected in a matter-of-fact manner, cutting across the preferences of rival theoretical positions. Finally, discipleship in one or another of the major schools is not characteristic of most psychologists working in the field of learning. There are strong tendencies toward mediating positions. Many writers have found the major contributions of the different schools largely reconcilable.
>
> The disadvantage of conflicting points of view are balanced to some extent by the motivation which a strong position provides its proponent and by the challenge it presents to its adversary. Out of the heat of controversy there is eventually scientific advance. Even in the midst of controversy, it is not necessary for the theorist to set aside reasonableness or critical powers. Theoretical differences show up most markedly where the data remain ambiguous, so that preferences hold sway over evidence. As the data become more securely established, it becomes increasingly possible to translate one system into another.

> While the state of knowledge is not therefore as bad as the parade of points of view makes it out to be, it is still rather unsatisfactory. There are no laws of learning which can be taught with confidence. Even the most obvious facts of improvement with practice and the regulation of learning under reward and punishment are matters of theoretical dispute [16, pp. 457-458].

More recently, James Deese, in summarizing the presentations of Luchins, Kendler, Postman, and others on the role of learning theory in the use of audio-visual media, began his commentary as follows:

> There are few topics about which any considerable number of psychologists appear to agree, and no topic is more likely to produce disagreement than learning. A superficial reading of the contributions presented here gives the impression of the babble of voices one has come to expect among psychologists. A careful reading of these papers, however, reveals that there is not so much disagreement or contradiction as there are differences in emphasis.
>
> Psychologists and schools of psychologists find different things to be important. Thus, some synthesis is possible. Indeed, when viewed this way, the papers presented here provide an astonishing richness of ideas, ideas that succeed in looking at the problem of audiovisual aids from just about every conceivable angle [4, p. 79].

Kanner, in reporting on the development and role of teaching aids in the armed forces, cites a statement by Webb as being a representative characterization of the attitude to learning theory of most applied psychologists:

> I turn back to the laboratory and I find experiments done on rats, sophomores in college, or sixth-grade students in which they were in a soundproof room responding to a buzzer or a bell or a nonsense syllable. Then some three hours later they were tested on Rorschach, Card VI. Some specific conclusions may be drawn, but while sound generalizations result from these procedures, they are applicable only to the extent to which you can re-introduce the laboratory controls,

> which you never can. Therein lies the disastrous position of one who attempts to apply learning theory in actual situations. . . . I can only be discouraging because in the three years I have spent at Pensacola occasionally attempting to apply learning theory, I have found no specific application of previous experiments other than indications of what variables to look for. I have never been able to apply specifically and directly any single experiment or any single finding presently existing in the realm of experimental psychology [18, p. 129].

Is it possible that, at present--and for some time to come, the task of applying research findings will be less a matter of routine application of "specific prescriptions" and much more a matter of exercising professional judgment in creating a compatible interaction between any "fact" and any "situation"? ? ?

Persons who are looking for more specific prescriptions may also consider what Professor Estes has to say about the role of theory of learning in education:

> No one will contest the proposition that, in some sense, the psychology of learning is fundamental to education. But even the fullest appreciation of the importance that each of these disciplines has for the other is not enough to ensure a harmonious and fruitful interplay between them. As the psychology of learning begins to show signs of maturity, one sees ever more clearly that its relation to education is going to be much more like that of physiology to medicine than like that of medicine to the patient. We find no rational grounds for expecting direct transfer of laboratory findings or direct application of basic psychological theories to problems of the schoolroom. False expectations in this respect by educators can only be a source of perpetual disappointment. Contributions that can realistically be expected from the science of learning growing out of experimental psychology are: (a) a deeper understanding of school learning, and (b) guidance in the planning and conduct of research on school learning.
>
> Both of these last points need qualification. It must be emphasized that understanding does not necessarily imply

> control. And further, to reap the benefits of understanding one must have a thorough knowledge of the best-developed theories and their experimental foundations. . . . Fruitful applications of basic learning theory require one, first of all, to understand that laboratory-based theories cannot be "tested" in the classroom. More generally, no theory in any field, once confirmed under conditions that satisfy its assumptions, can be "disproved" under conditions that do not. Further, one must realize that no psychological theory "favors" the teaching of any particular type of material. . . . Only when advice or opinions from theorists are being mistaken for deductions from theories can one, say, compare methods of teaching arithmetic which emphasize drill versus methods which emphasize the understanding of principles and relationships, while conveying the impression that one is testing the relative merits of connectionist *versus* field theories of learning. "Tests" of this sort are logically on a par with one that would appraise the relative contributions of chemical and electrical theories to the automotive industry by conducting a race between a stock model Chevrolet and a Sturges Electric [7, p. 752].

Summary and Interpretation

Speaking Figuratively, "Truth . . .

To summarize my remarks, I have suggested that the primary concern of Title VII activities is with the use of the new media in education. This concern may be regarded as focusing on the emerging field of educational technology whose problems range from the narrow and molecular to the broad and molar.

At the *molecular* end of the continuum lie the older problems, such as the differences between two basic elements of the media--the word and the picture. At this end, too, there already exists a modicum of practice-oriented theory.

At the *molar* end of the continuum lie the uncharted problems of education. These problems may be conceived as lying within a "systems engineering" framework.

. . . and Consequences"

If we grant that both research and application tend to be more effective when carried out within some explicit framework, one clearly evident consequence is the need for such a framework. This need, in turn, calls for a systematic analysis of the potential of this framework to contribute both to developing and carrying out significant research and making the findings operational in real situations. The question is, do we wish to be systematic? ? ?

A final observation which follows from my remarks is that the current status of behavioral theory in general, and new media and/or communication theory in particular, is that neither of the two suggested applications is easy to make. As a consequence, we are faced with (at least) three tasks:

1. We must encourage the development of "liberalized" theories of human behavior which bear upon problems in educational technology.

2. We must support systematic applications of educational technology in order to produce data and experience about problems of theoretical integration--as feedback for the theoretician.

3. We must identify and/or develop, and support adequate professional training requirements to enlarge the pool of competent talent available for the tasks which lie before us.

It is clear that success in these tasks will include the development of effective working relationships among, at least the three groups to which this Conference will be directing its recommendations: the educational profession in general, governmental groups such as the Office of Education, and informal groups such as the one which developed this Conference.

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Part IV

Reports of the Work-Discussion Groups

Report of Work Group A 241

Report of Work Group B 249

Report of Work Group C 257

Report of Work Group D 261

Report of Work Group E 271

Report of Work Group F 281

Report of Work Group G 289

Report of Work Group A

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Bureau of Educational Research and Service
College of Education
The Ohio State University

No Model, No Theory. . .

There is, I tell myself, an advantage in being first. Research on serial learning says that information presented first or last is better remembered than that which is presented in the middle. . . .

I think that I can speak for our group and for the entire Conference, in extending our thanks for the opportunity of coming here. I certainly enjoyed it, and I hope that you did too.

As far as I know, there is available no model of presentation--particularly when one is the first to present. I'm sure that, a little later, it will be possible to develop a model (or theory) based on the presentations of all the groups. However, since we have none, we shall strike out on our own--and use the model which was suggested earlier! ! ![1]

---

[1] The reporter's tongue-in-cheek reference is to a document, distributed to all participants, which suggested ways of organizing the work group reports. In general, Group A's report follows the structure suggested in this document--reproduced in Appendix E, Item 9.

To the Conference Sponsors

First on behalf of Group A, I should like to offer some comments on the Conference as a whole. Specifically, my remarks will be addressed to two aspects: structure and content.

Observations on Conference Structure.--Our group felt that a different and a more unique grouping of participants could have been made. One basis for such a grouping is suggested by Hoban's classification of individuals: logodemics [the scouts on the frontiers of knowledge], pandemics [the mediators between the theoretical and the practical men], and practidemics [the users of the knowledge discovered by the "logodemic" men and mediated by the "pandemic" men].[2] It is suggested that a grouping like the one indicated could have been made, and several advantages would have been gained. For example, each group could have formulated its own problems--in terms of the "new media" as it saw them. It could then have followed up in terms of its own interests.

Our group also noticed, and I'm sure that others did too, that some of the speakers repeated their working papers--instead of advancing beyond them.[3] In this connection, we wonder what use was made of the pre-Conference feedback sent in on the "Participant Reactions" forms.[4] In general, how effective was this procedure? How many of the forms were returned?[5]

---

[2] This three-element classification is discussed in Hoban's pre-Conference working paper, "Implications of Theory for Research and Implementation in the New Educational Media," given in Part II of this report, pp. 143-67.

[3] Appendix D, "Working Papers on Theory for the New Media," documents the attempts made to avoid duplicating the content of the pre-Conference working papers and the Conference presentations.

[4] The "Participant Reactions" forms were used for four purposes: (1) to help to involve the practicipants in the Conference, (2) to encourage pre-Conference study of the working papers and related materials, (3) to provide guidance for the resource people in the preparation of their Conference presentations, and (4) to generate data for the analysis and evaluation of the Conference. The forms are reproduced in Appendix E, Items 1 and 2.

At a more basic level, we seriously question whether a conference can develop a theory or a theoretical framework for "new media" research and application--or, for that matter, for any other subject or field of study.[6] We suggest a more practical, lower order question, "Is there any theory currently existing, in the natural or social sciences, which was developed by a committee?"

Observations on Conference Content.--On the matter of Conference content, our group thought that the working papers were rather limited. It seemed to us that they generally presented only an axe to grind or some comments on reported research. In several cases the relevance to the new media of a particular paper was rather limited.[7]

In a more positive vein, it seemed to us that more "growable" working papers could have been prepared. Possibly, more global treatments would have been more fruitful. The latter possibility is particularly attractive because of the heterogeneity of the work groups.

To Participants and to the Profession

These highly structured observations are addressed to ourselves, the Conference participants, to researchers, to new media practitioners, and to the related professions generally. They are, perhaps, too narrow, too specific. However, we believe that they merit careful consideration. I shall present them as points and clarify as necessary.

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[5] These questions, and related ones, are considered in some detail in the analysis and evaluation of the Conference which is being prepared under the title, Anatomy of a Conference.

[6] Although extensive provisions were made for clearly communicating the purposes of the Conference (documented, in part, in Appendixes B, C, and D) both to participants and to the planning groups, a preliminary analysis of the evaluation data clearly indicates that some of the participants did in fact interpret the major purpose to be theory formulation.

[7] The pre-Conference working papers are given in Part II of this report. The Conference presentations are given in Part III. Specifications for both the working papers and the presentations are outlined in Appendix D.

1. There is a need to define terms.

We need to specify what we mean by "medium," "media," "old media"--or whatever you want to call it,or them. The definition provided by Title VII of the National Defense Education Act was judged to be inadequate by our group. We need to develop criteria which will specify what a "medium" or "media" is, and which will discriminate between "old media" and "new media."

I was impressed by this matter as I read through one of the working papers. The "new media" were listed as radio, slides, film strips, movies, television, and teaching machines.[8] I thought back to when I was in public school--years ago. The only "new media" to which I had not been exposed were television and programmed instruction. I wondered why, many years later, all of the others had been classified as "new media."

2. There is need to develop a classification system for the various media.

There are many possibilities here. For example, there is Porter's classification of instructional devices.[9] Some of you may be familiar with it. You may recall that Porter's classification includes stimulus devices, response devices, and stimulus-response devices. . . .

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[8] The reference is to the working paper given in Part II of this report: "Implications of Theory for Research and Implementation in the New Educational Media," pp. 143-67.

[9] Douglas Porter, "A Critical Review of a Portion of the Literature on Teaching Devices, "Harvard Educational Review, XXVII (Spring, 1957), 127-47. The same article also appears in Teaching Machines and Programmed Learning: A Source Book (Washington, D. C.: Department of Audio-Visual Instruction, National Education Association, 1960), pp. 114-32.

3. Research on the new educational media ought to be carried out within the frame of reference of instructional objectives.

We must define instructional goals very precisely. The term "instructional goals," is a broad one. It includes immediate as well as long-range objectives--and all of the types of terminal behaviors. This term, we know, is presently highly popular in programmed instruction--but it does apply to all types of instruction.

For those who may not have seen it, I should like to suggest a good working paper on teaching objectives: Mager's handbook, Preparing Objectives for Programmed Instruction.[10] It is an excellent little document about how to develop and state instructional objectives in behavioral terms.

4. There is need to develop practitioners' awareness, understanding, and appreciation of the complex problems of sound research design.

Much is being said about the need for "middlemen" to mediate research communication between the researcher and the practitioner. There is, however, no substitute for adequate interpretation and application of research findings by the practitioner himself.

5. There is need to develop sophistication in experimental research design on the part of new media researchers.

Much of the new media research just doesn't hold water. If you are interested in testing this observation, I suggest that you look at some of the more recent research reports. For example, the "Research Month" issue of the Phi Delta Kappan reports an "award winning" study of teaching machines which has a weakness or two.[11]

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[10] Robert F. Mager, Preparing Objectives for Programmed Instruction (San Francisco: Fearon Publishers, 1962).

[11] The specific reference is to a study reported in Phi Delta Kappan, XLIII (March, 1962), 24-42.

If you should prefer a more "representative" sample, read the "Title VII Research Abstracts" which have appeared as supplements to recent issues of the Audiovisual Communication Review.[12]

6. There is need to develop multi-sensory or multi-dimensional measurement and evaluation instruments and devices.

The traditional paper-and-pencil achievement tests, given at the end of new media and other experiments, just do not do the job adequately. For one thing, they are too limited in the senses which they involve. Consequently, they can index only a limited range of the possible responses.

7. There is need for theory to undergird both research and practice in the new educational media.

At the present time, it is difficult to estimate whether any theory is potentially available. It is even more difficult to speculate about its nature or to specify its elements. We do not have the syntactic or semantic rules, nor the axioms or theorems.

Our group, with some hesitancy, identified what we think are basic elements. Although our terms are very generic and, undoubtedly, will have to be broken down, we offer this list for consideration: (a) the student, (b) the instructional goals, and (c) the media which "bring together" the student and the instructional goals. It seems to us, to use a phrase from the first working paper, many law-like statements could be made about these elements.[13] These statements could, of course, serve both as guides to practice and as bases for research.

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[12] The first installment of these abstracts, under the title "Research Abstracts and Analytical Review of Completed Projects: National Defense Education Act, Title VII," appeared as a supplement to the Audiovisual Communication Review, IX (July-August, 1961). The second installment, under the same title, appeared in Audiovisual Communication Review, IX (November-December, 1961). Undoubtedly, evaluation and analysis of the completed studies will be stimulated and, to some extent, future studies will be affected by the summary-critiques which precede each group of abstracts.

To the Office of Education

We also have some observations addressed to the United States Office of Education. Our recommendations are not listed in order of priority. We believe that all of them are important, and that decisions about the order of performance will have to be based on many considerations--and that some of these considerations cannot be anticipated at the present time.

1. Support and encourage new media projects and inquiries which focus on research design and methodology.

We include here projects which promise to lead to the development of new research designs, new methods, and new procedures.

2. Support and encourage investigations of the use of the new media in what might be called open-ended instructional situations.

For example, a complete lesson would not be presented by, say, television. Instead, only a part of a lesson would be presented by television. This part would be designed and/or designated to stimulate additional inquiry, exploration, or study. . . .

3. Support and encourage projects in which the emphases are on the efficacy of a medium (or media) to reach clearly specified instructional goals.

Comparative studies, such as television versus non-television or television versus teaching machines, are no longer needed.

4. Support and encourage conferences and workshops on research design for the new educational media.

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[13] The reporter is referring to the first working paper reported in Part II: Richard S. Rudner, "Structure and Function of Scientific Theories," pp. 29-57.

Such ventures could be developed around purposes and problems ranging from the very narrow and specific to the very broad and general.

5. Disseminate to practitioners the findings of new media and related research.

Such reports, whatever their form might be, should include indications of limitations and weaknesses in research design, instrumentation, and procedure.

. . . Finally, we have no category called, "miscellaneous." However, I do have one or two additional notes. The food was good. The Conference dinner was excellent. The companionship was highly enjoyable. . . .

Report of Work Group B

John E. Bicknell
Director of Educational Research
State Department of Education, Minnesota

Plan and Method

First, I'd like to join with the other group reporters and voice my appreciation, and that of Group B, for a very interesting and highly enjoyable Conference. Its structuring was excellent, and its execution has been of the same high quality. . . .

Our group approached its task by asking basic questions about education--about knowledge, learning, students, schools, and teachers. In a parallel way, we examined the nature and the potentials of the media of communication. Finally, we combined the educational and the media aspects, and tried to identify the place (or places) at which the so-called "new" media fitted into the educational process.

Some of our questions were simple. Now and then, they spilled over into areas of philosophy. At the same time, we were convinced that we had to go back to basics, and that our approach would lead us to places at which we might be able to establish more appropriate (compatible) and more productive (efficient) connections between education and the so-called, "new" media.

What Is Knowledge?

The first question we asked ourselves was, "What knowledge is of most worth?" By looking back upon our school experiences, we could sense more clearly how rapidly new knowledge was being generated; how quickly the things which we had learned as facts, as veritable truth, were becoming passé. About the only thing that has stood us in good stead throughout the years has been our knowledge of how to handle knowledge.

The relevant question, as we saw it, was, "How to use, how to apply, how to generate new knowledge?" Basically, knowledge is needed to make choices among alternatives, or to solve problems. In this context, "knowledge" includes not only the "factual knowledge" of school curricula, it also includes the social and cultural "knowledges" which we have to develop to get along with people--and with ourselves!

Following this line of analysis, we came to the realization that knowledge, in the curricular sense, has no intrinsic value--in and of itself. It probably won't make any difference if a person learns something, unless he does something with it; that is, unless he puts it to some use. Knowledge for knowledge's sake is, I think, a delusion. We want to know something for a purpose: the purpose is actually the use we shall make of that knowledge.

What Is the Function of the School?

We learn from the time we enter this world until we leave it. Learning is not a function which is unique to the school. However, the school does have an unique function to perform in connection with learning. . . .

We asked ourselves this question, "What is the function of the school?" Our over-simplified answer was, "The function of the school is to formalize the process of getting to know." In fact, school is about the only place left in which we can formalize this process!

During the school period, students must be equipped with the "skills of knowledge." Why? . . . So that, when they get out of school, they can keep on learning--and keep up with the rapid growth of knowledge. What for?. . . To find out something they need to know in order to do something somewhere. . . .

This line of asking and answering led us, eventually, to the conclusion that the emphasis in school must be on the process of learning rather than on the content of learning. Students need to know something for some purpose, not just to know it, but to put it to use. The learning process, in itself, doesn't do any good unless the students put it to use--and rather immediately. In total, the process of getting to know and the process of learning how to organize and how to handle knowledge, together with acquiring the tools (reading, writing, and thinking) to do so, are as important as the actual content which is learned. As a matter of fact, some of us think that the processes are more important. . . .

What Is the Teacher's Function?

Assume, for a moment, that the unique function of the school is to formalize the process of getting to know. A related question is, "What is the unique function of a teacher in such a school?" In answer, our group would say, "The teacher is the architect of the learning situation." Moreover, we would add, "One essential characteristic of a teacher-built structure is that, as quickly as possible, it makes the student independent of the teacher."

Furthermore, we would probably extend this independence principle to include making the student independent of any instrumentality to mediate his learning. That is, we would be saying that the student develops the skills, the attitudes, and the framework within which he can develop knowledge, use knowledge, and seek and find any additional knowledge he may need to achieve a purpose he has accepted--to do something somewhere. . . .

What Are the Functions of the Media?

I must say that we did not make any distinction between "new media" and "old media." We didn't see any differences that made any difference. Media are media. In communication they mediate, they perform a mediating function. They are the tools, the hardware by means of which we communicate. If we allow ourselves to become enamored with the hardware, and to over-emphasize its importance, we shall be harming our educational system.

The media of communication serve many functions. Our group listed a few of them. Undoubtedly, you can add to our list.

1. Stimulation or motivation. We mean, simply, that you can use a gadget or a gimmick to catch the interests of students. You can "make" them want to go out and learn.

2. Explanation or explication. The meaning we intend is to make clear, simple, or understandable. Explanation is one of the functions that can be performed by the media--by one medium, or by all of the media in combination. To explain, to make something understandable--how I wish we'd had more of it here and there during the Conference ! !

3. Simulation or representation. When we bring the outside world into the school, we often have to develop models of it with which students can work. We expect students to learn to use knowledge. One of the more effective ways in which they can do this is in real or life-like situations, and we can substitute for such situations by simulation.

Simulation implies making something which approximates the real thing. Students generally find it easier to work with an appropriate representation of something which is real--something from which the non-essential elements have been stripped. Too often, the non-essential elements associated with the real thing obscure the principles to be learned. In this sense, the media, "new" or "old," can perform an important function by providing a "mock-up" of the reality in which (or with which) students can operate.

4. Repetition or replication. Another function of the media is to recreate, to repeat, or to replicate. As teachers, we know that it is often not enough to receive one stimulus through one of the senses. Learning (of a higher order) is more likely to occur when a stimulus is received through many senses--or when several equivalent stimuli are received through several senses. Thus, any given stimulus which is transformed so as to have a simultaneous impact on "all" the senses can be expected to have a more powerful learning effect than a single stimulus received through a single sense.

5. Symbolization or abstraction. This function of the media resembles "simulation." The essential difference, as our group saw it, is that "simulation" represents or recreates reality; while "symbolization" indexes reality or creates something to stand for it. For example, a plastic model might simulate an automobile, but a surrealist painting of a human soul symbolizes.

Specifically, symbolization seems to be an essential sub-process of thinking. When we think, we generally use some kinds of symbols--language symbols or graphic symbols--to stand for various things. Quite often, the symbols we use are abstractions of some of the qualities of the things they stand for. In this sense, the media help us to take a real situation, develop symbols for its elements, and manipulate them in our minds.

6. Condensation or reduction. Many events which we wish to study in school have important space and time dimensions. They "spread" over space and time. To bring them into the classroom for study, we must compress or condense them. That is, we must reduce their space-and-time dimensions.

As teachers, we believe generally in the effectiveness of having students experience or "go through" the mental processes of building knowledge. We realize that some of the "original" processes took many years. Consequently, if the processes are to be experienced at all, they must be experienced in some miniature (or in some substitute) form. That is, they must be condensed. The media can be used to condense, to push together time and space so that the "things" of which they are significant elements can be brought into the classroom. For example, the media can condense the universe into a model: condensation or reduction is the primary process which yields models of the sun, moon, and the planets--although, undoubtedly, degrees of symbolization and abstraction are also present. . . .

To extend the last observation, notice that, in many cases of this general type, there are also the alternatives of relying, at least in part, on simulation and on symbolization. That is, we can approximate or simulate events--and this process will likely involve condensing space and time. We can also choose to develop symbols to stand for essential characteristics of the event.

Thus, in the case of a model of the universe, we might choose to create symbols for space and time; or we might prefer to ignore the space-time dimensions--perhaps because they are (relatively) less essential to our particular purposes of that moment.

7. Emancipation or liberation. Finally, the one thing which we saw as most important in this business of media functions, is emancipation. In this term, our group included both the process by which a student is freed of the teacher and, eventually, is freed of the media. Generally speaking, we saw the media and the teacher as being concerned primarily, though not exclusively, with that which was known. At the same time, we projected the student as becoming, progressively and ultimately, independent in his ability to gain, to organize, and to apply knowledge: the very functions in which the teacher and the media tend to be of greatest usefulness---although, of course, their functions do extend to other areas, and to other levels. At a given level of ability to discover, integrate, and use new knowledge, we saw the student becoming almost completely independent of both the teacher and the media--perhaps more independent of the teacher than of the media.

In more practical terms, when a youngster gets out of school, he is not going to be able to get needed information by turning on a motion picture projector. It isn't in the nature of things. However, we can speculate that, in the future, he ought to be able to punch a button and have a television monitor project needed information onto a screen. In the future, it is likely that the youngster will not be able to "lean" on the media--neither as heavily, nor in the same ways. For the school, one implication of this observation is that the use of media ought to be progressively different from the early years up through graduation. . . .

What Are the Functions of Theory and Research?

Functions of Theory. --It seemed to our group that, logically, one could not infer that there will never be a thing such as a "theory of media." However, it seemed that there would be theories of knowledge, of learning, and of education. Consequently, I don't think that we should worry too much about a theory for the media *per se*.

For teachers, regarded as architects of learning, the functions of a theory, any theory (learning, communication, society, or education) are:

1. To provide a framework on which to construct learning situations and experiences;
2. To provide a basis for establishing reasonable learning outcomes; and
3. To serve as a source of productive problems for research.

Functions of Research.--Our group distinguished between two functions. The first function, as we saw it, related to basic research. Now, how can I define, "basic research"? You may not agree with my definition, but I'd say that basic research is that research which has the expressed purpose of refining and developing theory. When we're talking about the educational media, I don't think that we need to worry much about this first function.

The second function relates to operationsl and systems research. In this sense, educational research is inquiry into the combinations of elements and the design and structure of learning situations. When we talk about research in the new media, I think that we need to talk about that kind of research which will allow us to use what we learn to optimize the total learning situation.

Report of Work Group C

Neville P. Pearson, Associate Professor
College of Education
University of Minnesota

Group Approach

Group C had a "shifting" committee to draft and check its final report. In reporting for the group, therefore, I shall try hard to convey the exact consensus of our deliberations. Consequently, I am going to read our report--more or less.

First, I should like to point out that our group is taking advantage of the permissive instructions regarding the structure and content of the discussion group reports. Second, I should like to observe that, if some of the work groups were up in the air, ours was the group that was at sea!! Third, I shall begin the report with some observations about our own work group experiences, proceed to some general comments about the Conference, and end with a look to the future. Our group's report is very concise. It has only three parts!!

Work Group Experiences

As our group proceeded with its task, certain definite feelings and needs began to emerge. I shall give them as four observations and a suggestion:

1. Early in our deliberations, it became clear that, in general, we were not secure enough to operate effectively in the theory context within which our research should be developed.

2. The group as a whole felt that communication was not as effective as it might have been.

3. Our group believes that the goal of translating theories into meaningful models and/or into components of program structure was not achieved.

4. With respect to subject matter or content, all members of the group feel that we need to know those research findings and those principles of human behavior which are generally accepted by social science theorists.

To sum up, we suggest that the foregoing statements could become the guidelines for our future plans of operation. In essence, they identify critical problems related to: (a) the nature and content of theory, (b) the problems of communication among disciplines, and (c) the task of learning about the significant findings of research.

The Theory Conference

Our general analysis of Conference organization and operation include four observations and a recommendation:

1. The Conference program was so organized that major emphasis and time were devoted to an airing of differences among theory specialists.[1]

2. The Conference participants represented several schools of thought and diverse points of view. Communication among them was not productive.[2]

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[1] The purposes and the general structure of the Conference are outlined in Appendix B. More specific details on program content and emphasis are given in Appendix C and Appendix D.

[2] The nature of the various work-discussion groups may be inferred from the list of participants given in Appendix F.

3. There were conflicts among the viewpoints of the resource people. The participants, many of whom had a practitioner's point of view did not become involved, in any way, in the resulting discussions.[3]

4. The conflicts among the resource viewpoints made prospective researchers reluctant to relate their problems to the research designs, theories, and findings of the subject matter areas represented by the Conference resource people.

In summary, Group C recommends that, for future conferences of this kind, participants be selected who can make maximum contributions to the solution of problems which are the particular concerns of the conference in question.

Questions for the Future

Future attempts to strengthen new media research and practice, in forms such as conferences, workshops, and publications, will have to make choices among many alternative goals. To assist in making such decisions, Group C suggests that the significant distinction is between these two alternative questions:

1. Should research tools be provided for the new media people?
2. Should problems be explored for the purpose of developing adequate research designs?

Postscript

This postscript is not just an after-thought. In part, it is intended to emphasize that the preceding comments are not to be construed negatively. Our group chose to look ahead to future potentials, rather than backwards to past accomplishments. Actually, our general feeling is that, at the Conference, we learned a great deal about the problems we face in research on the new media.

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[3] The viewpoints of the resource people are perhaps most clearly reflected in their working papers (Part II of this report) and in their Conference presentations (Part III). More specific data on the issue in question is provided in Part I of this report and, particularly, in Anatomy of a Conference--an analysis and evaluation of the New Media Theory Conference which is presently in preparation.

I must add that Group C was unanimous in the opinion that this was a stimulating, enjoyable conference, and a worthwhile experience. We all appreciated the opportunity to meet the fine people attending, and to experience the excellent services and facilities afforded us.

Report of Work Group D

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Northern Illinois University

Group D's Approach

After listening to the other groups' reports, I don't know if we were specific enough in our suggestions. However, I can say that we accepted our task and worked on it with the same positive spirit as we have experienced throughout these proceedings. . . .

We took our direction from the major Conference purpose, "To explore the nature and potential of a theoretical base for new media research and application." We then asked ourselves, "What do we need for this task?" Our answer was that, in order to find such a theoretical base, we would have to fill in the gaps along a continuum ranging from new media application or practice at one end to theory at the other.

Filling in the Gaps

In this connection, you may recall Dr. Bern's remarks about filling in the gaps along a molecular-molar continuum of problems of educational technology.[1] You may also remember an earlier reference to the "pandemic" man, and Dr. Bern's later suggestion that the "pandemic" man was the logical candidate for the task of bridging the gaps between theory and practice.[2] Our group agreed that the "pandemic" man would be an excellent filler of theory-practice gaps. However, we believed that it was also necessary for the practitioner, at the application end of the continuum, to look toward the theory end.

We observed that, speaking generally, the new media practitioner had little or no theoretical basis for the application aspects of his work. At the same time, we felt that the "best" use of the new media will come about when the practitioner himself becomes acquainted with the theories (and the disciplines) which are basic to his practice. From this we concluded that the greatest need for the new media practitioner was to master the content and the methods required for bridging the gap(s) between theory and practice.

In connection with this identified need, several members of our group found Adrian Ter Louw's concept of communication a helpful means for tying together practical and theoretical problems. I am asking a member of our group to present it as a part of our report.[3]

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[1] The reporter is referring to the presentation, "Toward the Reduction of a Difference-Signal," which is given in Part III of this report. More specifically, the reference is to a particular part of this presentation, namely, the discussion of Figure 5, "Molecular-Molar Continuum of Problems of Educational Technology." [Refer also to the footnote which follows.]

[2] The term "pandemic man" occurs in a classification scheme suggested in the paper by Dr. Hoban, "Implications of Theory for Research and Implementation in the New Media," in Part II. The gap-filling role of the "pandemic man" is discussed in Part III in Dr. Bern's presentation, "Toward the Reduction of a Difference-Signal." The particular section is entitled, "The New Media Component," pp. 194-211.

[3] The section which follows reports the presentation of Dr. Wesley C. Meierhenry, Assistant Dean, Teachers College, University of Nebraska.

Relating Theory and Practice

Two introductory comments before we examine this model of communication:

1. In our group, we gave a lot of attention to the translations which have to be made between a theoretical base on the one hand and practical application on the other. That is, we concentrated on theory "application": the process by which theories can be made to yield guides to practice.

2. The model I'm going to present illustrates a level of explanation which falls between the very general or loose explanations of communication (such as might be given by a practitioner) and the highly sophisticated, abstract explanations (such as accompany some of the models given in Bettinghaus' paper).[4] Within the framework which I shall present, the attempt is to draw upon theory at a level such that the products are acceptable to practitioners and recognizable by theoreticians.

This practitioner model of communication begins with the specification of objectives. [Refer to Figure 1 on the following page.] As programmers, methods specialists, and others say, these objectives must be stated in behavioral terms. The starting point is always a clear statement of the ends you wish to reach.

Next, in communication terminology, you need a SENDER of some kind. If you are thinking of teaching, the SENDER is the teacher.

The terminal element is the RECEIVER (or receivers). In the classroom, of course, this broadcasting term would refer

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[4] The paper in question, "Communication Theory and the Use of the New Media," is given in Part II. It presents models of communication which tend to emphasize the psychological aspects of the underlying processes. The model presented here tends to emphasize the order of the underlying processes.

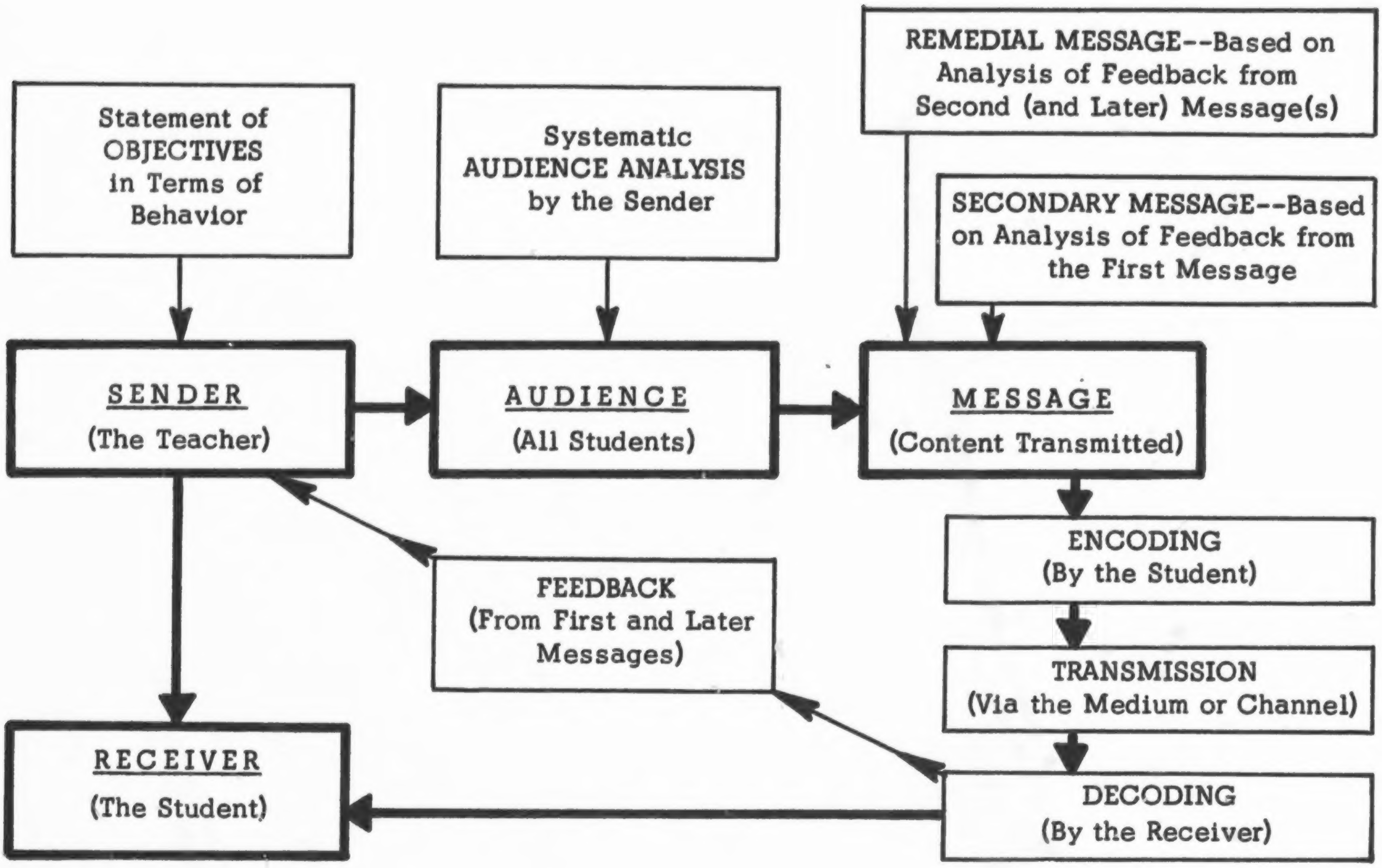
Statement of OBJECTIVES in Terms of Behavior
Systematic AUDIENCE ANALYSIS by the Sender
REMEDIAL MESSAGE--Based on Analysis of Feedback from Second (and Later) Message(s)
SECONDARY MESSAGE--Based on Analysis of Feedback from the First Message
SENDER (The Teacher)
AUDIENCE (All Students)
MESSAGE (Content Transmitted)
ENCODING (By the Student)
FEEDBACK (From First and Later Messages)
TRANSMISSION (Via the Medium or Channel)
RECEIVER (The Student)
DECODING (By the Receiver)

Figure 1.--Model of Communication to Aid in Translating Theory into Practice.

to the student (or students).[5]

At this point, we have the objectives (stated in terms of behavior), we have a SENDER (the teacher), and some RECEIVERS (students). The SENDER'S task is to translate the objectives into RECEIVER behavior which corresponds to the behavior specified in the objectives. For the purposes of illustration, let us say that the task will, in large measure, be achieved by means of appropriate communication with the RECEIVER--ignoring, for the moment, other alternatives.

As an initial, preparatory step, the SENDER makes a very systematic analysis of the AUDIENCE. In our classroom example, the AUDIENCE would be made up of "all students,"--that is, the general group to which the RECEIVER (the particular student) belongs. Guiding the suggested audience analysis are questions whose answers tell important things about the RECEIVER--"important" in the sense of indexing characteristics which suggest (imply) effective ways of communicating with him. Questions about, age, sex, intelligence, and related experiences, for example, would suggest the "best" way of reaching this particular RECEIVER with maximum impact.

At this point, notice particularly how this model permits you to take into account matters such as where the AUDIENCE is with respect to the stated objectives, its intelligence, its maturity, and so on.

The next step in this illustrative process is for the SENDER to encode (develop) the MESSAGE which will go to the RECEIVER. The MESSAGE will be only a part of a "campaign" which (hopefully) will help to change his behavior as specified by the objectives. The MESSAGE, then, is developed or encoded: (1) in terms of the objectives as stated, and (2) in terms of the nature of the RECEIVER as obtained from audience analysis.

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[5] In terms of essential elements, this model parallels the S-M-C-R model given in Figure 4 of the working paper, "Communication Theory and the Use of the New Media," in Part II, p. 102.

One of the reasons why this particular model has proved helpful is that it begins to specify the point at which media enter into the process of communication. It is at the encoding stage that one: (1) takes into account the content of the MESSAGE, or the subject matter which will be sent out, and (2) begins to structure or develop this content in terms of the nature of the AUDIENCE and the purposes to be achieved. In due course, one will have to decide on the medium (or media) of transmission.

Allow me to emphasize that transmission means no more or less than being certain that the RECEIVER is actually able to receive the MESSAGE. Media may be used as the channel of transmission. They are the means, not the process of transmission. They have nothing to do with developing the MESSAGE. The development of the MESSAGE comes before transmission, before the media come into the picture as means of transmission.

May I illustrate my remarks about transmission? TV is a means or a medium of transmission. It neither adds to, nor substracts from, the MESSAGE itself. It simply makes it possible to carry the MESSAGE to where it can be seen and heard--more generally, to be received, decoded, and so on. The same thing is true of loudspeaker systems, or of projectors. They are the means, or the media, or the channels of transmission.

The media, then, transmit the MESSAGE, the RECEIVER receives it, and decodes it. In our example, the student receives and decodes the MESSAGE. That is, he receives the MESSAGE and he abstracts meaning from it. The quality of the decoding depends directly on the success of all of the previous steps. Theoretically, if all of the prior steps have been carried out perfectly, there will be 100 per cent decoding following reception.

May I add these two points: (1) normally, in communication, "perfect" decoding does not occur; and (2) the model I've been discussing makes it possible to go back through the communication process to look for the points at which errors might have been made. Questions are asked: Was the assessment of the learner (audience) accurate? Was the message appropriate? Was it well designed?

To continue, feedback on the nature of the decoding comes to the SENDER in a variety of ways. In the classroom, for example, feedback may come to the teacher via paper and pencil tests, or in the answers given to oral questions. In short, feedback tells the teacher how well the student is "getting it," how precisely--i.e., how faithfully he is decoding.

The teacher compares the feedback with the specifications of the objectives, and decides that the student is not "getting it"--with the accuracy, to the degree, etc., specified by the objectives. She then encodes a new message, with adjustments to take care of the "errors" obtained from here analysis of the feedback. In effect, she triggers another cycle of communication, and the process repeats. Next, she may encode still another message on the basis of the additional feedback. . . . She continues correcting and adjusting until the feedback indicates that, in her professional judgment, maximally effective decoding has been attained by the student.

To repeat in general terms, and with reference to Figure 1, from the point at which feedback indicates that the primary (initial) MESSAGE was faulty--for a number of reasons. The process is:

1. A new MESSAGE, called a secondary MESSAGE, is encoded (developed). It includes adjustments made to correct the faults of the primary MESSAGE.

2. The secondary MESSAGE is transmitted, received, and decoded by the RECEIVER.

3. Feedback from the RECEIVER about the secondary MESSAGE indicates to the SENDER that certain faults are still present.

4. A third MESSAGE, called a remedial MESSAGE, is then encoded (developed). It includes adjustments to correct the faults of the secondary MESSAGE.

5. The remedial MESSAGE is transmitted, received, decoded, and feedback gets back to the SENDER. On the basis of this feedback, the SENDER may encode a fourth MESSAGE. . . and so on. . . until the feedback indicates that communication has been adequate.

In conclusion, let me repeat that the purpose of this particular model is only to provide a means for operating at a level which is not so abstract as to be hard in practice, nor so highly generalized as to be meaningless and therefore useless in any situation. . . .[6]

Conclusions and Recommendations

The remainder of Group D's report is a summary of conclusions, followed by recommendations. The recommendations are addressed primarily to the United States Office of Education and to the people working in the new media and related fields. However, we have also reserved some thoughts for the sponsors of this Conference.

To the Office of Education. --We believe strongly that there is need for seeking out and synthesizing all of the available information on theory and research findings which is related to, and potentially applicable in, the new educational media. We suggest, too, that this task is one which merits high priority.

1. We recommend that, as soon as possible, the relevant theoretical and research information be collected, synthesized, and made widely available to people who are working in the new media and related areas.

Our group also observed that, in many instances, the people involved in research are not aware of the problems found in using the new media. In particular, it seemed to us that researchers would benefit from first-hand knowledge about certain kinds of situations and problems. In turn, we anticipated that the new media people would have much to gain from exchanges with the people engaged in research.

2. We recommend that serious consideration be given to encouraging and supporting opportunities for increased contact and interaction among practitioners and research people--and those who function as mediators between research and practice.

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[6] Dr. Meierhenry's presentation ends at this point. The remainder of the group report is given by Dr. Tiemens.

To the Profession.--It is clear, of course, that neither our group nor any other can recommend actions involving any professional area without, at the same time, involving the people working in it. We felt, however, that a few words of encouragement, a little reinforcement, would not be out of order.

3. We urge professional people working in the new media, and in related fields, to support and to participate in, the systematic and rigorous development of the potentials of the new educational media by every possible kind of professional contribution.

To the Conference Sponsors.--We suggest that this Conference provided an excellent opportunity for interaction among the practitioners, the theorists, and the people who work at in-between levels. It also served the less spectacular function of making many of us face up to the real problems of the new media. It probably "rehabilitated" some of the people who were ready to run away from the problems. On the other hand, it may have "separated out" those who were more highly committed to the escape route. In any case, we suspect that our experiences here may have had some unanticipated impacts.

4. We recommend that a follow-up of the Conference be undertaken to obtain reactions from participatns after they have had any opportunity to reflect on what happened here.

Report of Work Group E

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State University of Iowa

Group Operation and Approach

My sympathies are with the groups which reported that they had been working under handicaps of one kind or another. However, I must say that our group functioned admirably. As secretary, I can say that it took very little effort to record comments and areas of agreement. We worked as a team from beginning to end. However, even though our group was very heterogeneous, we are unanimous (I think) in considering that "media" might qualify as a "dirty" word. . . .

To save program time, some members of our group intend to file individual comments in the "suggestion box."[1] Please note that these "suggestions and comments" are not the usual individual reports. In fact, they may be taken as unanimous reports of Group E. Although they deal with a wide variety of subjects, they are subjects on which the agreement was not only general but generally strong.

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[1] The speaker is apparently referring to the forms entitled, "Cogitations-Observations-Comments," which were used throughout the Conference to obtain feedback from participants. The content of these forms is being analyzed and will be presented in Anatomy of a Conference now in preparation. In general, this content was brief, addressed to Conference dynamics, and not identifiable with either individuals or groups. The forms used are presented in Appendix E, Item 8.

Our group decided to devote all of its reporting time to the subject which took up most of our working time, namely, the development of policy for new media research and application. The results of our deliberations are outlined on the sheets which were distributed to you a short time ago. [This outline is summarized in Figure 1 on the following page.]

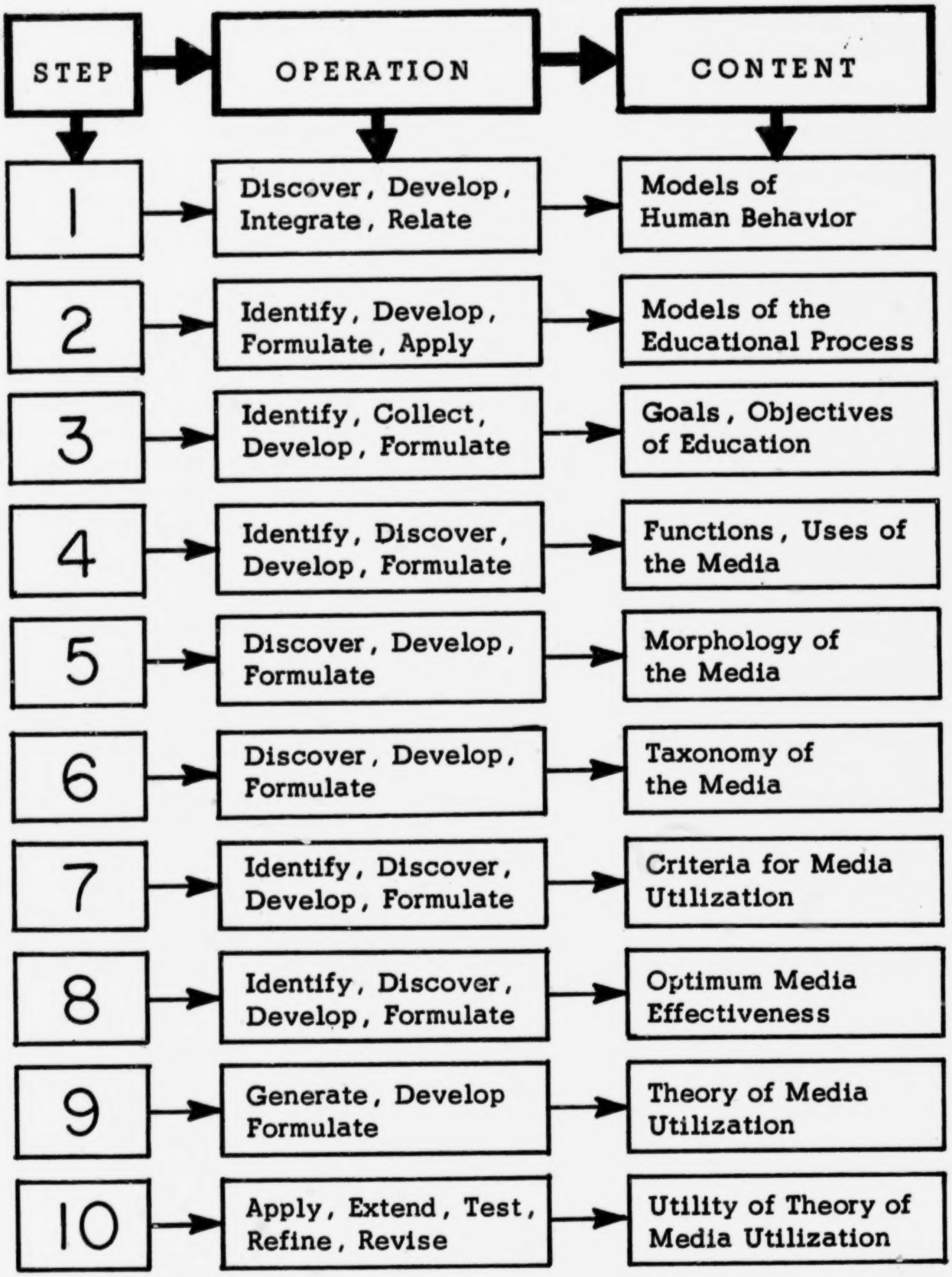
I must add that we considered the heterogeneity of our group to be a distinct advantage. We believe that the differences helped us to think through, and to develop, a better statement of policy than would have been possible if all of us had had similar backgrounds. Within the security of shared background, we might have been tempted to pool ignorance in the hope of producing knowledge. Because of our differing backgrounds, however, we believe that we have developed something more than an unctuous summary of innocuous generalities. . . .

Policy for New Media Research and Application

I hope that you will consult the outline [Figure 1] as I present our group's ten steps for developing a policy for new media research and application. As I present each step, I shall try to explain and illustrate it, and to discuss some of the implications.

> Step 1: We believe that there should be an organization of tenable, social-psychological models of human behavior which are relevant to the new educational media.

Please notice that we have used the plural, "models." We believe that it is important to avoid the possibility of choosing an inappropriate model. I believe that you will agree with us that the present stage of development of the social sciences makes it impossible to marshall adequate support for any single model.



STEP	OPERATION	CONTENT
1	Discover, Develop, Integrate, Relate	Models of Human Behavior
2	Identify, Develop, Formulate, Apply	Models of the Educational Process
3	Identify, Collect, Develop, Formulate	Goals, Objectives of Education
4	Identify, Discover, Develop, Formulate	Functions, Uses of the Media
5	Discover, Develop, Formulate	Morphology of the Media
6	Discover, Develop, Formulate	Taxonomy of the Media
7	Identify, Discover, Develop, Formulate	Criteria for Media Utilization
8	Identify, Discover, Develop, Formulate	Optimum Media Effectiveness
9	Generate, Develop Formulate	Theory of Media Utilization
10	Apply, Extend, Test, Refine, Revise	Utility of Theory of Media Utilization

Figure 1.--Ten Steps for Developing a Policy for New Educational Media Research and Application.

Step 2: The second step is the application of these models of human behavior to the process of education.

The process of education is not the static thing which we were lamenting a while ago. It is, to say the least, alive, active, and dynamic.

To give an example of what is meant thus far, how attitudes are generated and changed is explained by some models of human behavior (Step 1, above). How attitudes towards mathematics are formed and manipulated, and the influence on these attitudes of what is being learned and how it is being taught is an example of what we mean by the dynamics of the process to be discovered in Step 2.

Step 3: We suggest that a third step is to set up educational objectives.

This task will not be done for us by other disciplines. Further, we suggest that these objectives need not be subjected to value judgments, nor ranked in order of importance. On the contrary, they should be clear statements of the things we do, or are called upon to do, in facilitating learning. They should relate to the kinds of things which are to be learned--and we do not mean classification by subject matter areas such as Spanish, history, and mathematics. We do mean the kinds of things which an operations analyst would get in answer to the question, "What are the things you are trying to accomplish here?" That is, specify the objectives in terms of developments of, or increments, or changes in, skills, attitudes, values, etc.

We also suggest an additional refinement, the inclusion of investigations to determine whether any of these objectives are actually accomplished in the attainment of other objectives. That is, if any one of the objectives is being achieved, then the extent to which this process also achieves some (or all) other objectives should also be explored.

Step 4: Next, we suggest determining the functions of the media in achieving each of the educational objectives.

The general question is, "Does any medium facilitate, in particular, the accomplishment of Objective X?" We also suggest that the objective-achieving functions of the media might be formulated in ways which relate to, or reflect, the morphology (basic elements or form or structure) or the taxonomy (interrelationships among the morphological units) of the media.

Step 5: We suggest developing a morphology of the media.

That is, we suggest developing a classification system for the media based on "primitive" elements of form or structure--not of function. The term, "primitive" suggests "nothing below this level" and, consequently, the suggested categories may not be the most functional. Optimistically, however, there are many possible morphologies, and it should be possible to develop one which will meet our needs.

For example, we might develop a morphology such as still display, motion display, or pure tones of various kinds for auditory signals--or some other system involving the projection of pictures, the display of pictures, and so on. The point is that there are many possibilities for developing morphologies which not only provide adequate, non-overlapping "pigeon holes" for all the media which we have, but will also provide places for media which are presently unknown. Moreover, it is possible that this system will enable us to specify the characteristics of media unknown at present, and to suggest how to develop such media--if they are needed.

Step 6: As a sixth step, we suggest developing a taxonomy of the media.

In other words, the morphology will have given us the "pigeon holes" in which to classify the media. We must now formulate some systematic indications of the relationships among the "pigeon holes." The relationships might be stated in terms of variables such as content or educational function--or some other function. Moreover, the relationships might form a hierarchy; or they might include several dimensions or variables.

In total, it seems to us that, in order to conduct meaningful research or to develop efficient applications, we need an integrated framework consisting of systematic ways of: (a) classifying the media, and (b) specifying the relationships among the elements of the classification scheme.

Step 7: We suggest, as a seventh step, the development of criteria for utilizing each medium.

In general, we mean developing "use" criteria for each medium within the structure we have proposed. More specifically, we see these criteria-of-use as being stated in terms related to the morphology and to the taxonomy of the media.

The process of research illustrates how these criteria might be developed. For example, we might investigate a medium with A and B characteristics (i. e., the morphology) which fits here, at Y, in the hierarchy of relationships among the elements of the morphology (i. e., the taxonomy). The questions are: What can this medium do best? For whom? Where? When? Why? How?

Step 8: As an eighth step in developing a policy for new media research and application, we propose "optimization of the media"--for maximum effectiveness in achieving educational objectives.

Like the fifth and sixth steps, we believe that this step is particularly important. We are referring, specifically, to making each medium maximally effective in achieving each of the educational objectives identified in the third step. Further, we suggest that, in a learning situation, three kinds of variables will affect "media optimization": media variables, student variables, and learning environment variables.

The media variables will be implicit (and explicit) in the taxonomy of the media which is developed. Although we have used nouns and adjectives in giving examples of media variables (in the fifth and sixth steps), we are not really sure about what they may turn out to be. However, we can say that, in our system, a physically present teacher is one medium. The intended sense is that of the parallel statements, "Here is a teacher; here is a teaching machine." The intended sense is that of a teacher in the role of a medium when he is face-to-face with one or more students and is communicating with them live rather than through film--or through some combination of media. The known media (television, radio, film, etc.) might not turn out to be media variables since they were not designed for educational purposes.

The student variables are more predictable. I don't think that they need to be mentioned here. For example, academic ability, attitudes, and prior knowledge and experience might be relevant. To illustrate, I have repeatedly found sex differences to be significant factors in learning. However, all too often, we tend to overlook students' sex in considering use of a communication system.

When we mention learning environment variables, we do not refer exclusively to location--in Michigan or any other place. We refer more generally to such familiar (or unfamiliar) factors as class size, class organization, and group attitudes towards the teacher and towards the subject matter being considered.

Step 9: As our ninth step, we propose the generation of a theory of media utilization.

Our point of departure is the three-element structure of variables given in the eighth step: media, student, and learning environment variables. We do, of course, include all that is learned in all of the eight preceding steps.

At this point, we cannot say just what kind of theory of media utilization might be generated. It might be a single theory. It might be a set of interrelated theories--or an entirely new theoretical structure. However, if we already had available the data specified by the first eight steps, we could use them to develop a theory (or theories) for the utilization of media. Such a task could be undertaken at a conference such as this one--or in many other ways.

Step 10: Application of the theory of media utilization is the tenth, and the last, of our series of steps for developing policy for new media research and application.

I want to call special attention to it. Included, of course, is the application of theory in research. Included, also, is the idea of going back through each of the preceding nine steps and relating theory to it.

To illustrate, suppose that someone says, "I want to be able to teach Spanish with maximum effectiveness." Right away, our taxonomy of media in terms of educational objectives suggests many questions: What do you mean by "teaching Spanish"? What skills do you want to be acquired? How would you order them chronologically? How do you rank them in importance?

. . . After obtaining the pertinent information, we could (possibly) decide the best way to achieve objective A; for a particular student, B; in some particular learning environment, C; is to use a modified version of medium X. I use the term "modified" because perhaps no one has ever built a medium precisely like the one needed. However, notice that, by using a built-up structure like the one I have been outlining, we could describe and specify exactly what kind of medium was needed--and ask an engineer to build one.

This illustration of theory application carries many implications. For example, it implies the possibility of a new kind of educational setting. A student wishes to learn Spanish. An "assignment officer" questions that student, adds other data, and feeds the total into a computer. Out comes a card which says to the student, "Report to Room 101 at 10:30 a.m. on Mondays and Thursdays. You will learn precisely what you need to know--and learn in a way that is best for you."

Moreover, to extend an earlier reference to a made-to-order communication medium, I observe that the media which we use today must be selected (in general) from among those already available. However, once we have filled out the ten-element framework which has been described, it would be quite possible to specify precisely, and to develop with great efficiency, exactly the medium needed for that particular student, for that particular educational objective, in that particular learning environment. . . .

Major Recommendation

Our group has insisted on great precision in the wording of the following recommendation which served as a stimulus for our deliberations:

> Implicit in the thinking of this group is the assumption that present policies regarding the assignment of research

> *to individuals must be re-evaluated, not to exclude certain researchers or types of research, but to ensure that certain types of research for certain purposes at certain times will be carried out.*

Please note that we are not trying to usurp the entire new media domain. We are simply trying to encourage research which is directed toward meeting the purposes implied in our outline--and in about the order of priority suggested by our presentation.

I'm sure that our group is *not* asking the United States Department of Health, Education, and Welfare, or any other agency, to abandon support of research which takes larger steps into the unknown. What I am saying is that, in the opinion of the group, it is *not enough* to support just *any* well-designed research on just *any* educational media problem. Provisions ought to be made for orderly, sequential analysis and solution of general problems of media utilization in performing the various functions which, taken as a whole, are the enterprise known as education.

Looking Back and Looking Ahead

In concluding for our group, I should like to add that we have enjoyed this meeting of minds. We feel that we have benefited from the experience of being here. We believe that, six months hence, we shall be in position to know more specifically how all of these things have affected us in how we teach, in how we operate, and in how we do research. But, at present, and in the jargon of the setting, "We would tend to suppose that it has probably been stimulating!!"

As we leave for home, we look back on this venture not as a termination but as a beginning. We leave with renewed vigor, and with greater purposefulness . . . and with optimistic expectations of what may lie ahead.

Report of Work Group F

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School of Science, Education, and Humanities
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Report Structure

Our group found it difficult to divide its report into the four categories suggested.[1] Therefore, we shall use only two.

The first part of our report includes comments and suggestions about the Theory Conference itself. It is directed to the sponsors of the Conference. The second part is directed both to researchers and to the United States Office of Education. Our group felt that the concerns of the Office of Education and those of researchers in general were so similar that a distinction was not worth making.

To the Conference Sponsors: Observations and Comments

Some of the numbered items which follow are "observations." As such, they are offered as points at which revision and strengthening of the Conference were possible and, we believe, desirable. Our suggestions for strengthening are usually implicit in the observations. In other cases, the items are given in the more explicit form of suggestions and recommendations. They suggest particular ways of strengthening the Conference--without excluding additional alternatives.

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[1] The reporter is referring to an outline which suggested that the discussion group reports might deal with: (1) Conference organization and content, (2) strengthening new media research and application, (3) improving research dissemination, and (4) sharing unique products of the group discussions [Appendix E, Item 9].

In sum, our "observations" are permissive and general. Our "recommendations" are intended to be less permissive and less general. In both instances, however, the underlying intent is not to limit the exploration of additional alternatives but to encourage the consideration of, at least, some of the implicit and explicit possibilities.

1. It seemed to us that, either (a) the participants were heterogeneous as to level of research sophistication, or (b) the resource people assumed too high a level of participant sophistication.

In any case, the level of the formal presentations was generally high. In this connection, many members of our group felt that they would have liked to have been "insulted" by Dr. Rudner.[2]

2. It seemed to us that there were not enough different types of activities included in the program.

This meant that concentrated effort was required for too long a period without change or relaxation. Perhaps scheduled tours of the campus, or some other "concrete" activities, might have given a much-needed break in the Conference.[3]

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[2] The reference is to the introduction of Dr. Rudner's pre-Conference working paper which presents a tongue-in-cheek analysis of the dilemma of how a speaker's level of presentation tends to insult some proportion of his audience. Refer to the first paper of Part II of this report.

[3] In total, about two-fifths of the Conference working time was allocated among informal, non-program activities. Details on the nature of these activities are reported in Anatomy of a Conference, an analysis-evaluation of the Theory Conference now in preparation--and are reflected in the Conference program, Appendix E, Item 3.

3. More Conference time should have been devoted to the application of partially formulated theory and to conceptual schemes in the area of new educational media.

This suggestion contrasts with the Conference's concern with the development of theory itself.[4]

4. Participants had no feeling of belonging to a group, nor of being committed to a group task.

We do not know whether the development of such group feelings was intended or expected. However, we did observe that, as individuals, the participants were stimulated by the Conference materials.

5. The inclusion of resource people trained in related social science disciplines and in the philosophy of science was unique and stimulating.

In particular, the approach and the contributions from the philosophy of science were highly relevant and valuable. Equally significant were the reactions among the resource people.

6. The availability of the resource persons to the participants was valuable and highly desirable.

At the same time, it is likely that limitations of time made it impossible for all participants to benefit fully from these opportunities.

7. The excellent physical facilities added significantly to the effectiveness of the Conference.

In general, the total atmosphere facilitated the basic processes of the Conference.

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[4] The Conference's concern with theory development is perhaps most clearly indexed by the first working paper of Part II, "Structure and Function of Scientific Theories." The rationale underlying the approach used is discussed in Appendix D.

8. The resource people might be encouraged to modify or to revise their pre-Conference working papers and/or their Conference presentations.

It occurred to our group that some of the resource people may have changed some of their views as a result of their Conference experiences. If our speculative observation should be true, the resource people should be encouraged to revise their working papers and/or their presentations to reflect such changes.[5]

9. A report of the Conference should be widely circulated.

It should go to research people, and to practitioners in the new educational media and in related fields. The goal should be to provide an opportunity for the greatest possible number of people to benefit from the ideas of the resource people and from exposure to some of the thinking of the Conference participants.[6]

To Whom It May Concern

The comments and suggestions which follow are addressed to all who are interested in new educational media research and application. Our group recognizes that certain observations may be more relevant to one group than to another. At the same time, we believe that our conclusions have important over-all implications for researchers, for new media practitioners, and for the new media research and dissemination programs of the United States Office of Education. . . .

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[5] An attempt to follow this suggestion yielded these results: (1) minor changes in the pre-Conference working papers (Part II) and in the Conference presentations (Part III), and (2) a decision to eliminate publication of three of the Conference presentations because they duplicated (essentially) the pre-Conference working papers.

[6] After considerable delay, distribution of the Theory Conference proceedings will follow the plans outlined in Appendix B (last section) and in Appendix C (last three sections).

1. There does not seem to be a need for developing a new theory for the new educational media.

We believe that most new media problems can be restated in terms of behavioral science theories which already exist. We believe, however, that the relevance of particular theories to new media problems is an area which needs to be investigated.

2. "Conceptual schema" which are directly related to the new educational media should be developed.

Such "schema" would meet the immediate needs of new media researchers, and contribute to the fruitful investigation of problem areas. Undoubtedly, they would also be helpful to new media practitioners in interpreting and applying the findings of research. Note that this suggestion is intended as an addition to our first point: to determine the relevance and utility of already available theories in the behavioral sciences.

3. Methodology for developing conceptual schemes should be outlined.

For example, it appears that people in philosophy of science are equipped for this task. The approach might be analogous to that used in the pre-Conference working paper on the development of formal theory.[7]

4. The potential values of a conceptual scheme are its identification of elements and their relationships, and the provision of a framework for testing.

Such a conceptual scheme would: (a) include elements from the new educational media, (b) include elements from behavioral science theories, (c) provide for identifying relationships among new media elements and elements of related behavioral science theories, and (d) delineate the relationships within existing theoretical frameworks which probably should be subjected to further empirical testing.[8]

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[7] The reference is to the first working paper in Part II, "Structure and Function of Scientific Theories," pp. 29-57.

[8] Note how Group F's third and fourth points relate to elements of the policy plan outlined in Group E's report, pp. 272-278.

5. The possibility of bridging the gap between the "logodemic" man [the scout on the frontier of knowledge] and the "practidemic" man [the user of knowledge] may be realized by new media researchers acquiring training in one or more of the basic social science disciplines.[9]

This suggestion is additional to, and may also be a substitute for, the explicit development of conceptual schemes which was mentioned earlier. To extend the idea of conceptual schemes, we observed that the new media training might provide an implicit scheme (or schemes), while the basic discipline training might aid in implementing a program of hypothesis testing.

6. Persons now in the new media field should become familiar with the significant research literature of at least one of the basic social science disciplines.

More specifically, we suggest that such people collect this literature and integrate it into their individual systems of professional operation.

7. The United States Office of Education ought to consider sponsoring multi-discipline work sessions to develop basic research materials for new educational media researchers.

For example, ventures which, in many ways, parallel this Conference may have much promise. Four or five representatives of the basic social science disciplines and philosophy of science might be assembled to develop a major paper on some aspect of research which also would be of high value to new media researchers--and to new media practitioners.

8. In stimulus-response terms and with reference to the new media, the multi-dimensionality of the stimulus makes evident the need for multi-dimensional analyses of the data collected from such situations.

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[9] The terms "logodemic" and "practidemic" are taken from the last pre-Conference working paper, "Implications of Theory for Research and Implementation in the New Educational Media"--the last paper in Part II, pp. 143-67.

At this Conference it has been suggested that we must look at the stimulus values of the new media machines; at the object, content, or the message presented; at the nature of the sources; and at the characteristics of the various individuals involved.[10] There are, of course, many additional possibilities. . . .

9. New media researchers should consistently try to make explicit the concepts with which they are dealing.

This matter of precise definition is crucial. For example, rather than to state the relationship between two operational variables, an attempt should be made to state the relationship between the indexing concepts which have been operationalized. Consequently, when the relationship in question is applied in another situation, the new data will have reference both to the basic concepts and (through them) to the operational variables.

In Summary

Without repeating all of the comments and observations offered by Group F, permit me to summarize by highlighting these broad aspects of our report:

1. Our group agrees with much that has been reported by other groups, and our report identifies some of the major areas of agreement.
2. Our analysis of the Conference itself yielded indications of both strengths and weaknesses, and we gave major attention to the positive problem of maximizing strengths--and to the possibility of adding to their number.

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[10] The specific reference is to the discussion of the model of communication presented in Group D's report--particularly the section entitled, "Relating Theory and Practice." In addition, a more general reference to Group E's report may be intended--in particular, the discussion centering around the discussion of Figure 1, "Ten Steps in Developing a Policy for New Educational Media Research and Application," p. 273.

3. For the good of the professional order, our group developed specific suggestions for strengthening new media research through the refinement of critical aspects of research process and methodology, and through self-improvement by researchers.

4. For the consideration of the United States Office of Education, we suggested specifically the encouragement and support of multi-disciplinary task groups working on significant and manageable problems in new media research and application.

Report of Work Group G

M. Daniel Smith
Coordinator of Self-Instruction
Earlham College

Relation and Operation

In presenting the last report, I have a unique opportunity to tie in all of the preceding reports: this involved trying to follow the reports and, at the same time, to make changes in my manuscript. Some of the changes are in very small writing. So please pardon my close attention to the manuscript. . . .

Our report is organized much like that of Group F. That is, we have chosen to combine our observations and recommendations. However, I'm sure that you will be able to group our statements according to the categories suggested in the handout on group reports.[1]

In some respects, our report is similar to that of Group A. In other respects, it resembles Group C's report. For example, our observations and suggestions relative to the Conference itself have much in common with those of Group A and Group C.

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[1] The reporter is referring to the explanatory document, "Suggestions for Work-Discussion Group Reports," given in Appendix E, Item 9.

Analysis of the Conference

As already mentioned, our recommendations and observations directed to the organizers and sponsors of the Conference repeat some of the items already reported. Our statements are divided into two lists: a list of weaknesses, and a list of strengths.

Conference Weaknesses.--I shall present the weaknesses first. Our group noted these five areas:

1. It often seemed that the resource people overlooked reactions to their pre-Conference working papers.[2]

2. Some of the resource people did not allow sufficient time in their Conference presentations for give-and-take with the audience.[3]

3. The resource people might have been "instructed" to be more eclectic in their presentations, and to avoid a too conspicuous commitment to a particular position.[4]

4. The initial focus of the Conference might have been on typical problems in the new educational media, and then gravitated to more basic, theoretical concerns.

It seemed to our group that such an order of development would have served as an "ego-involving" device for the participants. In addition, this approach, if it had been followed, might have encouraged more positive and more closely related contributions by the resource people. Instead, the process of development was just the reverse.[5]

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[2] Pre-Conference reactions to the working papers were collected by means of participant reaction forms which are described and illustrated in Appendix E, Items 1 and 2. The reactions were used to guide the Conference presentations of the resource people and for evaluation purposes. The reactions submitted are analyzed in Anatomy of a Conference now in preparation.

[3] Provisions for discussion of the major presentations are reflected in the Conference program given in Appendix E, Item 3.

[4] Formal "instructions" on the nature of the Conference presentations are outlined in Appendix D. The presentations themselves are given in Part III of this report.

5. *The participant selection procedure sometimes resulted in inappropriate participants being invited.*[6]

A closer analysis indicated that this difficulty occurred most often in the case of substitutes. Please note that our comment is not directed against "outsiders." It merely reports how some members of our group felt about *themselves* as participants.

In total, the foregoing observations indicate what our group considered to be the five major weaknesses of the Conference. We believe that, in general, they reflect our conviction that the organization of the Conference was basically sound. We believe that, in the future, we ought to concentrate on strengthening this particular organization rather than to work on developing a new one.

Conference Strengths.--Our group's observations on the strengths of the Conference also number five:

1. *The idea of placing the working papers in the hands of participants prior to the Conference and soliciting their reactions was excellent.*[7]

2. *The small group sessions were often very stimulating and productive.*[8]

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[5] Data related to this observation may be found in Appendix B, Section II (also in Appendix C, Section III, and Appendix D, Section II); and in the Conference program (Appendix E, Item 3).

[6] An outline of the procedures followed in selecting participants is presented in Appendix B, Section II, and in Appendixes A and C.

[7] Relevant to this observation are the provisions for obtaining pre-Conference feedback outlined in Appendix E, Items 1 and 2.

[8] The underlying rationale is reflected in the Conference working documents dealing with the work groups--Appendix E, Items 4, 5, 6, 7, and 9.

3. The Conference facilities were excellent.[9]

4. The Conference agenda did not make unreasonable demands on participants.[10]

5. The Conference was well paced.[11]

Systems Analysis of the New Educational Media

In relating our report to the reports of the other discussion groups, I notice particularly how our analysis related to the "communication model" presentation of Group D.[12] You will see the parallelism as I continue. . . .

An Identification-Definition Approach.--Our group found that identifying and formulating (defining or specifying) new media problems was a task which was both extensive and time-consuming. We used the theoretical concepts presented in the formal sessions as reference points. Perhaps a more accurate description is, "We tried them on for size." In any case, we did not find these concepts very fruitful--as seems also to have been true in Group C.[13]

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[9] The purpose-related role of Conference facilities is noted in Appendix B, Section II.

[10] Aspects of the Conference program are considered briefly in Appendixes B, C, and D. The actual program is presented in Appendix E, Item 3.

[11] Note that Group F reported an opposite view of Conference processes--the second point in the report section entitled, "To the Conference Sponsors: Observations and Comments," p. 280.

[12] The reference is to the section of Group D's report entitled, "Relating Theory and Practice," pp. 263-68.

[13] The reference is to the introductory section of Group C's report entitled, "Group Approach," p. 257.

Consequently, early in our discussions, we decided to strike out on our own. Our goal was to "boil down," to reduce the many aspects of the new educational media to a framework within which we could work comfortably. Speculatively, it was our hope that, once the basic structural factors of process (or whatever) were identified, the various media could be incorporated according to their unique contributions to the whole--a "systems" approach, to use a popular term.

The Media and Teaching-Learning.--We first considered the education-new media approach already discussed by Group B,[14] but on a more general level, and in less detail. We then went on to what seemed to be a more basic consideration: the interaction of words and graphic-pictorial presentations. In numerical-summary form, our analysis of this topic proceeded somewhat as follows:

1. It may not always be possible to teach exactly the same things by printed texts, by television, or by teaching machines. Each medium may be expected to yield different outcomes. In addition, these different outcomes may be expected to show up at different stages of the evaluative process.

2. The projected, different outcomes may be expected to be related to the "stimuli" (messages) which "cause" (trigger) them. That is, the instructional outcomes will be closely related to the nature of the stimuli sent out via the instructional media. Consequently, we believed it necessary to analyze the instructional messages--as suggested in Group D's report.[15] The purposes of this analysis would be to decide how to encode the instructional content (in terms of purpose) and, in turn, to decide which medium (or media) ought to be used.

3. Basic to our analysis is the assumption that the nature of the content should receive more attention since it connects the third (educational objectives) and the fourth (functions of the

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[14] The reference is to the approach outlined in the first section of Group B's report entitled, "Plan and Method," p. 249.

[15] The reference is to the section of Group D's report entitled, "Relating Theory and Practice," pp. 263-68.

media) steps in Group E's model of education and the new media.[16]

4. In order to determine the most effective combination of communication and medium, the analysis of the communication must take into account the nature *both* of the content to be learned and the learner. It must also recognize that messages which follow the initial message will be designed to take into account the feedback which comes back to us from the earlier message(s).

5. The instructional message, as encoded and transmitted, is directed to an audience conceived as a *dual* entity: (a) the community of learners, and (b) the community of subject matter experts.

6. To follow our suggested approach would, in effect, parallel the advice of the "typical" teaching machine expert who insists on two rules-of thumb: (a) "the program is the thing," and (b) "specify the learning outcomes, *then* determine how they may be realized in the optimal manner through the new (and/or the old) media."

7. It is important to note that we are assuming that certain social factors will affect the specification of the instructional objectives and the nature of the encoded instructional messages. They will also have some (perhaps direct) bearing on the medium (or the media) selected. In addition, we believe that economic factors will be involved in the total process--at the encoding stage and, particularly, at the transmission or the media-selecting stage. However, with respect to the process as a whole, we see the economic factors as being of secondary importance.

To sum up our deliberations in more general terms, and to emphasize two general guides to action, we suggest that, for effective teaching by the new educational media:

1. *Develop the media, the mechanics, and the machinery at a secondary level of priority; and*

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[16] The reference is to the section of Group E's report entitled, "Policy for New Media Research and Application," pp. 272-78.

2. Place primary emphasis on the educational goals, and on the requirements of the processes of teaching and learning.

The goals and the requirements of teaching and learning will determine the nature of the media machinery.

Personal Footnote

Speaking for myself, primarily, I should like to add three "personal" observations on the Conference:

1. The group sessions were most interesting and, to me, the most worthwhile part of the Conference.
2. We did experience a degree of group identification, and we did enjoy a sense of achievement.[17]
3. A personal regret, not fully shared by our group, is that we were not able to consider some of the questions of research design raised in Hoban's paper.[18] To me, this topic seemed to be one of the most important items which we might have considered.

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[17] Contrast with Group F's comments on the small group sessions and particularly, on the matter of group identification--in the section of Group F's report entitled, "To the Conference Sponsors: Observations and Comments," pp. 281-84.

[18] The reference is to the last paper in Part II entitled, "Implications of Theory for Research and Implementation in the New Educational Media," pp. 143-167.

Part V

Appendixes

A. Regional Planning Conference 299

B. Theory for the New Media 303

C. Conference on Theory for the New Media in Education . . . 313

D. Working Papers on Theory in the New Media 325

E. Conference Working Documents . . . 341

F. Participants in the Theory Conference Project 361

Appendix A

Regional Planning Conference

This Conference is the first easy-to-identify step in the process which led to the New Media Theory Conference. It was held at the Kellogg Center for Continuing Education at Michigan State University. The participants who attended came from educational and related voluntary and commercial agencies and organizations in seven midwestern states: Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio, and Wisconsin. The names, addresses, and affiliations of the participants are given in Appendix F. The sections which follow summarize the major aspects of the Planning Conference.

I. Nature and End Product

Nature of the Planning Conference

The Planning Conference was a non-structured, highly permissive, and creative experience. The task of the assembled group was characterized as: "Planning ways of strengthening the research and/or dissemination aspects of the program of research being developed under Title VII of the National Defense Education Act." At the outset, it was emphasized that, although there was a "ninety per cent" commitment to the use of the conference method, the remaining "ten per cent" of the planning could be as original and as daring as needs and conditions might suggest.

In keeping with this assignment, about one-half of the Conference was devoted to identifying, exploring, and weighing alternative needs and approaches. The other half of the Conference, approximately, was directed toward conference planning as guided in general, by the more significant purposes which had been established.

Report of the Planning Conference

The formal report of the Planning Conference is based on four types of data: (1) the stenographic transcript, (2) correspondence with participants, (3) suggestions taken from the experimental "doodle record" which encouraged participants to record observations, comments, appraisals, and speculations occurring during the Conference, and (4) written and verbal analyses and reactions of members of the Title VII Conference Committee* and of observer-participants from Michigan State University.

These data were interpreted and weighed as objectively as possible. In interpreting the data, greatest weight was given to the stenographic record of the Conference. The resulting report was reviewed by the Title VII Conference Committee. The sections which follows are taken from a summary of this report.

II. Summary of Planning Conference Report

Projected Purpose, Content, and Vehicle

There is a high degree of agreement concerning the major purpose of the venture, if any, which is to follow up the Planning Conference: To strengthen the new media research program. Specifically, this purpose is seen as being distinct from an emphasis on the dissemination, interpretation, or application of the findings of new media research.

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*Conference Committee members are listed in Appendix F.

Equally clear is the consensus that a theoretical or conceptual framework for research on the new educational media should have first priority as potential content. Lower order priorities are assigned to content concerned with dissemination, interpretation, or the application of the findings of research.

The participants recognized that, operationally, the conference approach, assumed as "given" in the Planning Conference, would have to be related to purposes. They suggested that many difficulties would beset any venture which might set out to strengthen the new media research program via a conference. Apparently, the general relationship seen was that, depending on purposes, the conference approach could have little to a great deal of "natural" potential as a possible means for achieving the ends specified.

Participants and Representation

The majority recommendation was that the follow-up venture, if concerned primarily with the role of scientific theory in new media research, should involve active research leaders in the new media and in related fields. It was suggested that these people might come from new media research and from related research in education and in other social science disciplines.

If appropriate and possible, and keeping potential impact in mind, a limited number of participants might be drawn from research, education, and social science administrators; educational program leaders; and classroom teachers. In general, participants in the projected follow-up venture might well be a larger cross-section comparable to that of the Planning Conference.

It was agreed that the follow-up venture, or conference, ought to be regional. However, if this alternative is followed, representation and participation should be extended in the case of resource people and/or in the case of key participants. A degree of national leadership representation is deemed necessary to maximize impact in the direction of the accepted purposes.

In total, the discussion of this topic indicated that the conferees were particularly concerned about: (1) the problem of identifying regional resource people as contrasted with the problem of identifying regional participants, (2) the problem of criteria or policies to guide sponsored and non-sponsored Conference attendance and participation, and (3) the alternatives for participating in ways additional to conference attendance.

Guides for Planning

The follow-up venture, whatever its reliance on the conference method, ought to be a means to a larger end. It should not be an end in itself. It would be most appropriate, for example, for a conference to initiate an action program or to serve as an essential step in launching an action program in the area of new media research.

In view of the implied commitment to the conference method, and the indication that the conference would be used to the full extent of its potential for achieving the suggested purposes, the participants drew on their professional experiences to offer valuable suggestions concerning: (1) effective ways of handling specific content at a conference; (2) key people to develop, to lead, and to take part in conference activities; (3) using new media and other materials (including exhibits) to stage and support, and to illustrate and reinforce the major topics and the underlying theme of the conference; and (4) involvement of participants before, during, and after the conference.

Appendix B

Theory for the New Media

This document is an abstract of the proposal, submitted to the United States Office of Education, requesting support for a "Regional Work Conference to Explore the Potentials and the Problems of a Theoretical Framework for Conducting Research and Applying the Results of this Research on the New Media in Education." It specified the operational dimensions of the Theory Conference Project and provided background information for the Regional Advisory Committee. It also provided a stable policy framework for the planning activities of the Michigan State University Title VII Conference Committee. The membership of both Committees is given in Appendix F.

I. Background and Objectives

Origins of the Theory Conference

The Work Conference outlined herein was developed as an outgrowth of a Regional Planning Conference held at Michigan State University--and summarized in Appendix A. It was attended by twenty-five public school, college, and university representatives from seven states: Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio, and Wisconsin. This task force addressed itself generally to the problem of strengthening the new educational media research program of the United States Office of Education.

More specifically, the planning group concerned itself with identifying and elaborating upon a productive approach to improving the quality of the new media research being undertaken and with ways and means for encouraging greater and more perceptive application of the results of this research. The outline which follows, based upon the deliberations of the Planning Conference, proposes a Work Conference on Theory for the New Media in Education.

Theory Conference Objectives

The general purpose of the Work Conference will be the strengthening of the new educational media research program by focusing on the role of theory in planning and executing research and in applying the findings of this research. A major related purpose will be wide dissemination of the deliberations of the Conference--in terms of both content (proceedings) and analysis (evaluation).

The specific objectives of the Conference are projected as follows:

1. To explore the nature and the potential of a conceptual framework, a theoretical base for executing new media research.
2. To explore the nature and the potential of theory in the application of the findings of new media research.
3. To experiment with new ideas in conference programming by applying the principles underlying the new media.
4. To develop, by way of a final report, a major publication examining the role of theory in new media research and in the application of new media research results.

II. Theory Conference Structure and Development

Program Structure

In general, the theme of the Work Conference will be developed by means of a few highly selected presentations followed by appropriate group discussions and reporting assignments.

Each presentation will deal with some aspect of theory. The introductory presentation will examine the nature, the function, and the development of theory in the social sciences in general and in the new media in particular. Later presentations will concentrate on proposing, developing, and analyzing theories for new media research and application. The closing presentations will include examination of the problems and potentials of operating from particular theoretical positions, both in terms of executing research and in terms of applying research results.

To achieve this theory, research, and application focus, these specific program content elements are proposed:

1. Nature, function, and development of theory.
2. Learning theory base for the new educational media.
3. Communication theory base for the new educational media.
4. Social theory base for the new educational media.
5. Problems and potentials of theory-based research.
6. Problems and potentials of theory-based application.
7. Group discussions and work assignments following each presentation.
8. Discussion-work reports of the groups.
9. Conference summary, evaluation, and future plans.

Conference Development

The general pattern of development of the Theory Conference shall be:

1. Introduction, orientation, and general organizational activities incident to getting the Conference under way;
2. Presentation to the total Conference of each major element of content, with provision for questions, comments, and clarification;
3. Division into small work groups for critical examination, discussion, and the preparation of a report on the Conference topic in question; and,
4. Repetition of this cycle, and concluding with a final summary session for work group reports, forward planning, and Conference evaluation.

The major Conference presentations and the reports of the groups will be integrated into a formal project report. It is anticipated that a combination of quality presentations, pre-Conference briefing of participants, the discussion and reporting at the Conference, and a measure of post-Conference revision and refinement will yield content for the major professional publication projected in the Conference objectives.

III. Resource People and Participants

Resource People

Carefully selected people will be asked to prepare original papers on each of the major Conference topics. The selection of these people shall not belimited to the midwestern region. Primary criteria for selection shall be:

1. Knowledge of, reputation in, and/or identification with the area of the Conference topic in question;

2. Ability to relate areas of own professional interests-activities to the new media;

3. Ability to write and to speak clearly and effectively;

4. Ability to use-demonstrate-apply educational and new media principles.

The resource papers will be duplicated and used for pre-Conference briefing of participants. In any particular case, the Conference presentation may include the total paper, and/or some selected aspects of it. Additionally, each resource person will have a modest budget allowance for any "new media" materials which will make his presentation an unobtrusive demonstration of the new media theme underlying the Conference as a whole. Thus each paper will be presented with reinforcement from every available new media device and technique, and will become the basis of group consideration and reporting.

Conference Participants

Conference participants will be selected from the seven midwestern states which were represented at the Planning Conference: Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio, and Wisconsin. The key resource people, consultants, and group discussion leaders may be drawn from a larger geographical area.

The guiding criteria for selecting Conference participants shall be:

1. Identification with, and/or active in new media research and/or in general social science research and/or in general social science research or theory as related to the new media;

2. Potential new media research people, and academic administrators and other educational leaders in a position to contribute to, and to encourage, the support of new media research and application.

3. Outstanding professional practitioners active in new media research and/or in the application of the results of such research--from education and/or from the new media.

The majority of the Conference participants will be drawn from new media research and from related areas of social science research. Active research people, social science and new media theorists, research and educational administrators, and potential research people will be included. Since the Conference will be directly concerned with research application, some of the participants will be selected for their leadership positions in channeling research ideas and findings, and in stimulating the application of the results of research.

Not more than sixty State participants will be invited to the Conference. Ten additional participants will be included because of their leadership positions in research stimulation, support, dissemination, and application. Five or six people will be invited to serve as the key resource persons. General consultants and discussion leaders will be selected or elected from the Conference group as a whole. The total Conference group will be held to a maximum of about seventy-five people.

IV. Means and Ends

Organization and Administration

The Work Conference is being planned for five days, March 11-15, 1962. It will be held at the Kellogg Center for Continuing Education at East Lansing, Michigan. The Kellogg Center is the nation's largest laboratory for students of hotel and institutional management; and provides staff and complete facilities for special courses, conferences, and a wide variety of adult education activities.

The detailed development of the Conference shall be the responsibility of the Michigan State University Title VII Conference Committee. Representatives attending the initial Planning

Conference shall be invited to serve as an advisory group. In addition, consultants from the Michigan State Office of University Conferences, and from other divisions of the University, will be called upon to assist in setting up a conference which will be effective, productive, efficient, and highly creative in execution.

The Planning Conference participants shall be formally designated as a Regional Advisory Committee. Committee membership shall be voluntary. If necessary, alternates shall be appointed by the MSU Committee to provide at least one representative per State. The responsibilities of the Regional Advisory Committee shall be:

1. To advise, on request, concerning general and particular features of the Conference on Theory in the New Media in Education;

2. To assume a functional role in the pre-Conference and post-Conference communication and information activities;

3. To assist in selecting Conference participants, consultants, resource people, and group discussion leaders; and,

4. To serve, in general, as a source of ideas and advice aimed at improving any aspect of the Conference.

Executive responsibility for the Theory Conference shall be vested in the Michigan State University Title VII Conference Committee. This Committee shall be composed of the representatives of the sponsoring divisions--Continuing Education Service, College of Communication Arts, and College of Education--and such others as the sponsoring representatives shall select. The major responsibilities of this Committee shall be:

1. Selecting a Conference Director to carry out the executive duties and responsibilities of the Conference;

2. Directing, on a policy level, the development and the execution of the Conference plan and program;

3. Directing, in general, the allocation and expenditure of Conference funds;

4. Selecting Conference participants and resource people from those nominated by the Regional Advisory Committee and by others; and,

5. Coordinating the advisory activities of the Regional Advisory Committee.

The administrative unit for the Conference shall be the Continuing Education Service. General Conference administration shall be under a Conference Director. Budgetary responsibility for the funds granted shall be vested in the Office of University Conferences of the Continuing Education Service.

Outcomes and End Products

Two types of Conference outcomes are anticipated: Outcomes in terms of people, and outcomes in terms of things. The major end results that are anticipated may be listed as follows:

1. Appreciation and understanding of the role of theory in the execution, application, and promotion of research on the new media in education;

2. A core group of people--within the region and within each state--directly and indirectly committed to the professional spirit of inquiry implicit in the Conference, and potentially available to develop and to promote various aspects of the new educational media research and dissemination program;

3. A quality set of presentation materials available for use in other exploratory, explanatory, and developmental activities of the new media research program; and,

4. A Conference report which will serve as a vehicle of dissemination and as a professional reference for the

larger audience which could not be accommodated at the Work Conference.

If nature, scope, and quality warrant, a major theory-and-application publication could be developed from the Conference report. This publication could serve as a handbook for research workers, administrators, teachers, students, and others. It could also serve as a means of strengthening research and dissemination efforts in the new educational media and in other areas of human behavior.

Appendix C

Conference on Theory for the New Media in Education

This booklet, prepared as a mimeographed document, describes in detail the nature of the "Regional Work Conference to Explore the Potentials and Problems of a Theoretical Framework for Planning and Conducting Research and Applying the Results of Research on the New Media in Education." The booklet was enclosed with invitations to the Conference, and was mailed out about three months before the dates of the Conference. It provided more than the traditional amount of information about the Conference, and made it possible to use short letters of invitation. The booklet was also used for reference by the various Theory Conference Advisory Committees, and for briefing the Conference resource people. The membership of the various groups is listed in Appendix F.

I. Highlights of the Venture

WHAT ? ? ?	Regional Work Conference to Explore the Potentials and Problems of a Theoretical Base for New Media Research and Application.

WHEN ? ? ? ?	Sunday, March 11th to Thursday, March 15th.
WHERE ? ? ?	Kellogg Center for Continuing Education, Michigan State University, East Lansing, Michigan.
WHO ? ? ? ?	Researchers and theorists in the new media, communication, education, and supporting areas of the social sciences; research and educational administrators; and professional educators in public schools, colleges, and universities.
HOW ? ? ? ?	Through the sponsorship of the United States Office of Education in cooperation with the Continuing Education Service, the College of Communication Arts, and the College of Education at Michigan State University.
WHY ? ? ? ?	To strengthen the new media research program, both in terms of the research that is undertaken and in terms of the dissemination and application of the results of this research.

Conference participants will be reimbursed for travel and subsistence expenses.

II. Purposes, Content, and Design

The New Media and Conference Purposes

Throughout this discussion which follows, the term new media is used in the sense suggested by the National Defense Education Act of 1958. To illustrate: ". . . television, radio, motion pictures, and related media of communication. . ." and ". . . motion pictures, video tapes and other audio-visual aids, film strips, slides and other visual aids, recordings (including magnetic tapes) and other auditory aids, and radio and television program scripts. . . ."

The specific purposes of the Theory Conference are: (1) to explore the nature and potential of a theoretical base for new media research and application; (2) to experiment with conference planning and programming; and, (3) to develop, as an extension of the project report, a significant publication on the role of theory in new media research and application.

Conference Content

The Theory Conference is developed around five content areas drawn from the social sciences. The first content area provides the basic framework. The second, third, and fourth areas furnish selected samples of specific content which fit into the basis framework and contain direct implications for the new media and for the social sciences generally. The fifth content area integrates the theme and subject matter of the Conference. The five areas of content are:

1. Nature, function, and development of scientific theory theory;
2. Learning theory as a base for new media research and application;
3. Communication theory as a base for new media research and application;
4. Social theory as a base for new media research and application; and
5. Potentials and problems of new media research and application based on theory.

Conference Design

The total design includes pre-Conference briefing and post-Conference follow-up. The Conference itself is built around a series of five presentation-clarification-discussion cycles. Each cycle centers one of the five content areas, and includes three phases:

1. Clarification-reinforcement-extension of content made available to participants for pre-Conference study and reaction;

2. Analysis-comment-questioning by the total-Conference group; and,

3. Extension-application-evaluation by small working groups.

At the Conference, the five cycles are to be preceded by a brief orientation session and followed by a concluding session devoted to group reports and Conference evaluation. Conference follow-up will consist of preparing and distributing a formal report, fulfillment of the commitment to develop a professional publication, and appropriate action on any recommendations, plans, or commitments formulated by the Conference participants.

Basic elements of the content and organization of the Theory Conference are presented graphically in Figure 1, following.

III. Rationale and Development

Basic Conference Principles

The general principle underlying the Theory Conference may be summarized by the dictum, "Practice what you preach!" In more concrete terms, this general principle breaks down into a series of more specific operational principles, such as:

1. A conference can demonstrate-illustrate the doing of those things which a conference does best.

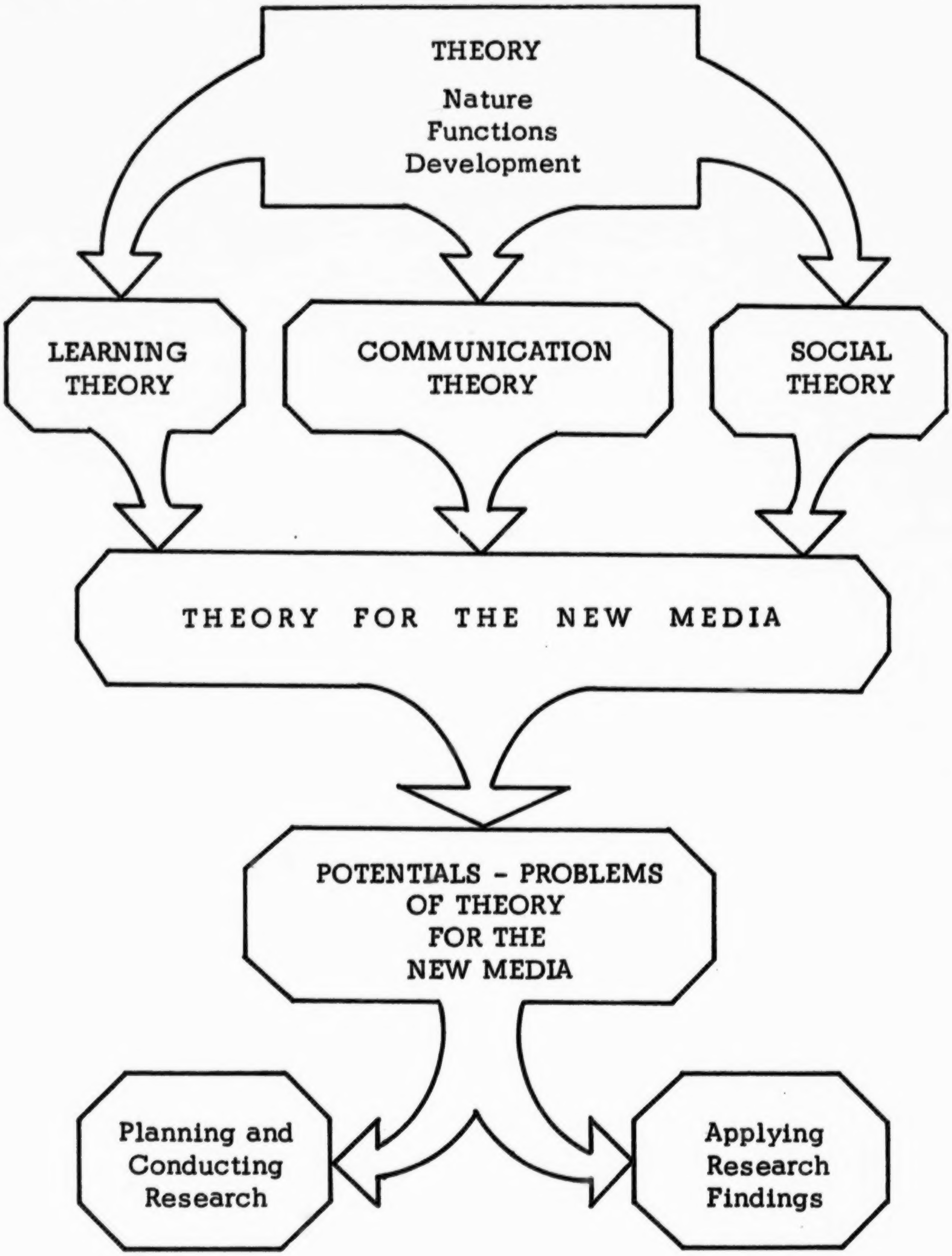
THEORY
Nature
Functions
Development
LEARNING THEORY
COMMUNICATION THEORY
SOCIAL THEORY
THEORY FOR THE NEW MEDIA
POTENTIALS - PROBLEMS OF THEORY FOR THE NEW MEDIA
Planning and Conducting Research
Applying Research Findings

Figure 1.--Content and Organization of the Work Conference on Theory for the New Media in Education.

Extension: There must exist more compatible and efficient conference functions than the reading of papers which participants are fully capable of reading for themselves.

2. A conference can play a significant role in a planned program of communication.

   Extension: There must exist a more efficient and compatible role for a conference than a limited period of oral, one-way message transmission with little or no provision for before or after-the-Conference preparation or reinforcement.

3. A conference can maximize its effectiveness by applying or practicing the more significant implications-for-action of the content with which it deals.

   Extension: A conference concerned with new educational media and with the application of the findings of new media--and related--research will tend to increase its effectiveness according to the degree to which it makes appropriate application of such findings.

The foregoing general and specific principles, and others which can be abstracted in parallel ways, are basic to the Theory Conference. Conscious attempts to identify and "allow" for them characterize every aspect of the Conference. For example, this document is intended to tell you more about the Conference than is "normally" contained in letters of invitation.

Conference Development

Additional illustrations of the foregoing principles of process and function are provided by the items below. These items also give additional information on the nature of the Theory Conference:

1. Conference participants are identified-nominated-selected-invited by a process involving the Michigan State and Regional Committees--and others.

2. Conference participants are given detailed information on the nature of the Conference and are provided with copies of Conference subject matter (the "working papers") and related materials (selected abstracts and bibliographies).

3. Conference presentations supplement and extend--THEY DO NOT REPEAT--the working papers, and take into account the pre-Conference comments and questions submitted by participants.

4. The Conference is devoted to the more unique functions of assemblies: group interaction, discussion, study, and planning.

5. Provisions made for Conference follow-up in the form of a formal report, and appropriate action on recommendations, plans, and/or commitments which the participants may choose to develop.

Conference Resource People

The Michigan State and Regional Committees combined forces to identify and recruit talented and creative resource people. These people have been at work on papers and presentations for several months, coordinating and integrating their efforts through direct (group meetings) and indirect (correspondence) planning. We plan to prepare brief professional biographies on each person, but some preliminary identification may be helpful to you now:

"Nature, Function and Development of Theory":

Dr. Richard S. Rudner
Department of Philosophy
Michigan State University

"Learning Theory Base for the New Media":

Dr. Frank A. Logan
Department of Psychology
Yale University

"Communication Theory Base for the New Media":

Dr. Erwin P. Bettinghaus
Department of Communication Arts
Michigan State University

"Social Theory Base for the New Media":

Dr. Morris Janowitz
Graduate School of Business
University of Chicago

"Potentials and Problems of New Media Research and and Application based on Theory":

Dr. Charles F. Hoban
Annenberg School of Communication
University of Pennsylvania

Conference Participants

The majority of the participants to be invited will be selected from the seven midwestern states to be served by the Conference. In addition, a small number of participants from outside the region will be invited to attend. The total group, including the resource people, will number no more than 75.

In general, the Conference "audience" will reflect the purposes of the Conference. The largest number of participants will be identified with, and/or active in, new media and/or areas of research. A smaller number will be educational and research administrators in strategic positions to encourage and to support new media research and application. Another smaller group of participants will be outstanding teachers from public schools, colleges, and universities. The latter group will have its closest ties with the application aspects of new media research.

IV. Products and Plans

Conference Outcomes

The outcomes of the Conference are projected in terms of people, knowledge, and things. In terms of people and knowledge, we shall look for evidence of:

1. An active appreciation and understanding of the role of theory in new media research and application; and,

2. An active, core group of people potentially available to support, promote, and to undertake new media research; to play appropriate roles in the dissemination and application of new media (and related) research findings; and to support efforts aimed at more complete realization of the goals of the Conference.

Stated in terms of things, the Conference should yield:

1. A collection of effective presentation materials available for general teaching and demonstration, and for specific explanatory-promotional efforts in behalf of new media research and application.

2. A report which may be used as a professional handbook, as a basis for a more complete publication, and as a source of suggestions for strengthening new media research.

Conference: Next Steps

If you've skimmed the outline up to this point, you will have gained a working impression of the Theory Conference, and of how hard it is to say simple things briefly and exactly.

A list of next steps may be a useful summary. . . .

1. An early reply to our invitation will be appreciated. Please do not hesitate to ask questions or to make suggestions at that time.

2. We shall acknowledge your letter, confirm arrangements, and. . . .

3. About six weeks before the conference, we shall send you copies of the five working papers which make up the subject matter of the Conference. Please note again that the Conference presentations will be extensions, elaborations, and/or reinforcements of the papers, NOT REPETITIONS.

4. You will be asked to study the working papers and to send in questions and comments. Please note, again, that the Conference presentations by the resource people will take into account the questions and ideas which you submit.

5. About three or four weeks before the Conference, we shall send you additional content and resource material. This material will probably consist of key readings, abstracts, and selected bibliographies.

6. About two weeks before the Conference, we shall send you specific information on the program and on arrangements and facilities. We shall try to clear up problems as we go along. Last-minute adjustments, notes about things overlooked, and other materials will be included in a folder which you will pick up when you register.

7. DURING the Conference, you will be invited-encouraged-stimulated to play an active and compatible (for you) role in the proceedings.

8. AFTER the Conference, you will be encouraged to fulfill a proportionate, individual share of the commitments made at the Conference.

To end on an introspective-philosophical note, we believe that the Conference will provide you with genuinely worthwhile personal and professional experiences. The nature and significance of these experiences will be directly related to the spirit and effort expended before, during, and after the Conference. . . .

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BACKGROUND OF THE NEW MEDIA THEORY CONFERENCE

The Conference on Theory for the New Media in Education grew out of a regional planning meeting attended by representatives of public schools, colleges, and universities in seven midwestern states: Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio, and Wisconsin. The general concern of this meeting was the problem of strengthening the new media research program of the United States Office of Education. More specifically, the meeting attempted to identify and to develop an approach for improving the quality of the new educational media research being undertaken, and for encouraging appropriate application of the results of this research.

The initial planning meeting was sponsored by the United States Office of Education in cooperation with the Continuing Education Service, the College of Communication Arts, and the College of Education at Michigan State University. The major area of consensus proposed the development of a conference concerned with the theory for the new media. More specific planning and action since that time have been carried on by the Michigan State Title VII Conference Committee working with a Regional Advisory Committee working with a Regional Advisory Committee.

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NOTE: The names and addresses of the Michigan State University Title VII Conference Committee and the Regional Advisory Committee were given at the end of the foregoing document.

In this report, these names and addresses will be found in Appendix F, "Participants in the Theory Conference Project."

Appendix D

Working Papers on Theory in the New Media

This mimeographed booklet gives suggestions for developing the pre-Conference working papers for the "Regional Work Conference on the Role of Theory in Planning and Conducting Research and in Applying the Findings of Research on the New Media in Education." It also reviews major elements of the mutual understandings and commitments of the resource people and the administrators of the Conference. The resource people were brought together on two occasions prior to the Conference: initially to plan and outline their papers, and later to discuss and revise their preliminary drafts. The booklet was also used to provide information for the Michigan State University and the Regional Advisory Committees. The resource people and the members of the various committees are identified in Appendix F.

I. Approach and Setting

Suggestions, NOT Directions

These suggestions for developing the working papers for the Theory Conference are specific extensions of the point of view and the ends and means outlined in the document, "Theory for the New Media." [Appendix B.] It is NOT the purpose of this outline to dictate the specifics of the working papers.

It IS the purpose of this outline: (1) to present the program framework into which the working papers will be integrated; (2) to describe, in terms which are more illustrative than mandatory, an approach which promises to yield the learning-integration-reinforcement we seek; (3) to outline the major reciprocal commitments which will be involved; and, (4) to summarize the time schedule and related arrangements for seeing the venture through to completion.

Work Conference Structure

Figure 1 on the following page pictures the structure and the development of the Work Conference. It represents our attempt at specifying ends and means. Although all relevant factors, as we saw them, were taken into account, we consider the illustrated structure as subject to any modifications which promise improvement.

Several elements implicit in Figure 1 should be emphasized:

1. The Work Conference is conceived as a learning and developmental experience in which scientific theory is the vehicle, and an examination of the role of theory in new media research and application is the goal.

2. The Conference is built around five major presentations on theory. Each presentation is related to the new media and to the other presentations--in different ways and in varying degrees.

3. The general pattern of development of the Conference is that of formal presentations followed by group discussions and reports.

4. The order of the Conference presentations is fixed only with respect to the initial, general presentation on

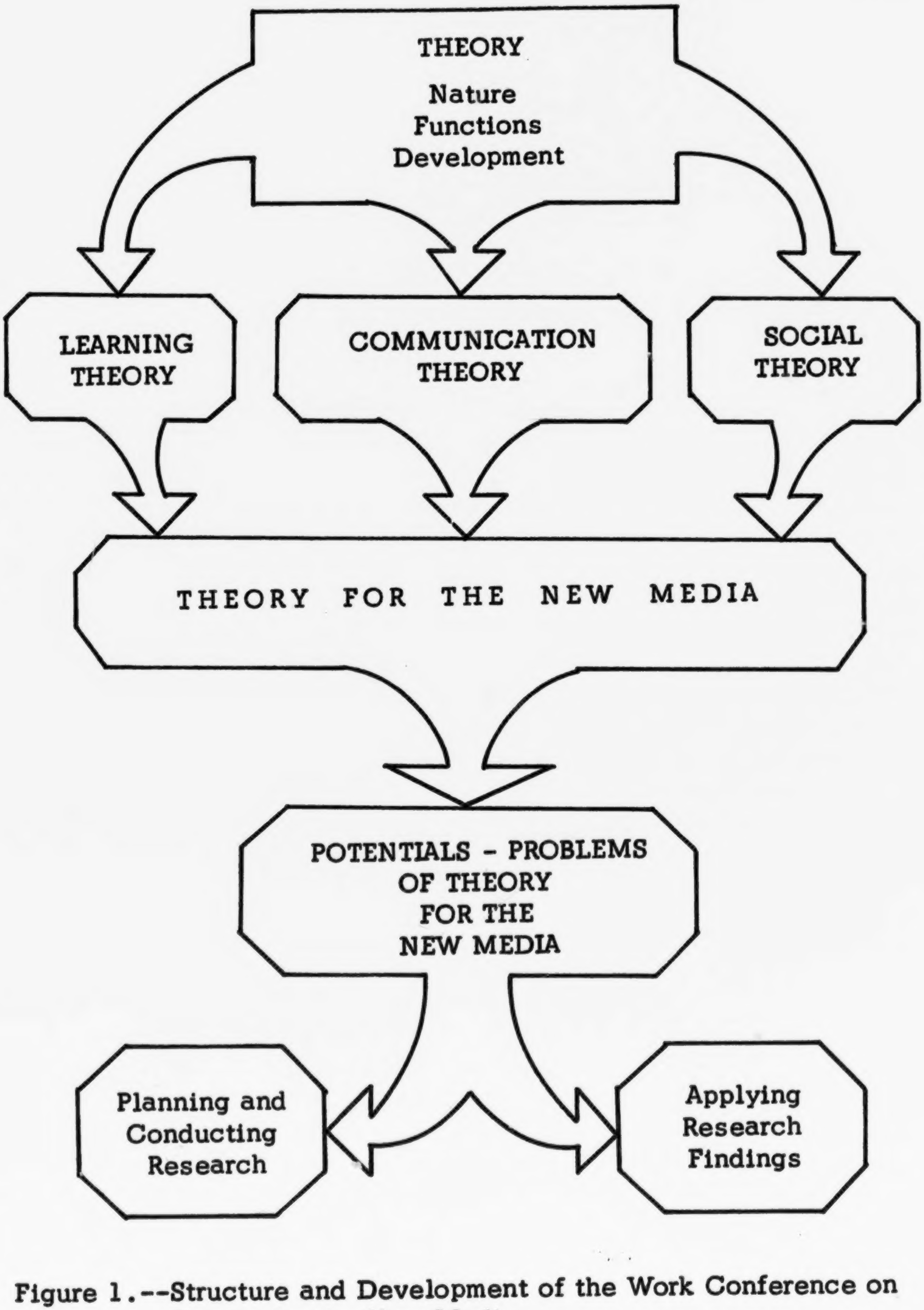
THEORY
Nature
Functions
Development
LEARNING THEORY
COMMUNICATION THEORY
SOCIAL THEORY
THEORY FOR THE NEW MEDIA
POTENTIALS - PROBLEMS OF THEORY FOR THE NEW MEDIA
Planning and Conducting Research
Applying Research Findings

Figure 1.--Structure and Development of the Work Conference on Theory for the New Media.

theory and the final presentation on the application of theory.

5. In addition to the integrating concern with scientific theory as related to new media research and application, the Conference will achieve integration by means of direct cross referernce among the presentations--and in other ways.

Major Assumptions

The major assumptions particularly relevant to the commitments and responsibilities of the resource people are:

1. It is assumed that there will be provisions for both pre-Conference preparation by participants and for post-Conference follow-up.

2. It is assumed that most of the Conference participants will have a degree of sophistication and considerable experience relevant to the theme of the Conference.

3. It is assumed that the oral presentations at the Conference will, in general, select from, emphasize, and/or extend the content of the working paper papers--with appropriate reinforcement stemming from sound, professional use of new media principles and devices.

4. It is assumed that there will be an opportunity for the resource people to review and to integrate their presentations prior to the Conference.

II. Working Papers and Conference Presentations

Levels of Presentation

As implied in the section, "Work Conference Structure," various levels of abstraction in the treatment of the subjects are, and will be, encouraged. By way of illustration and explanation, three levels of abstraction are suggested in the paragraphs which follow.

Highest Level of Abstraction. --The highest level of abstraction is proposed for the first working paper and presentation, "The Nature, Function, and Development of Theory." The perceived concern is with scientific theory in general, that is, with theory as it is found in all of the sciences. This level of generality suggests a treatment which may be less concerned with relation to the new media than with a cogent presentation of the significant characteristics of theoretical systems.

If it is deemed that examples are desirable and possible, there may be more concern with theory in human behavior than with theory in the physical sciences. It seems less likely that there will be a direct and major emphasis on theory in the new educational media, but it may be possible to draw a few examples and illustrations from this field.

Middle Level of Abstraction. --A second or middle level of abstraction is proposed for the learning, communication, and social theory working papers (and related Conference presentations). It is expected that these papers can (and will) be more closely related to the new educational media than will the initial working paper on "pure" theory. Thus, one might observe that: (1) communication is the new media; (2) some kind of learning is often projected as an objective in the educational use of the new media; and, (3) both communication and learning do occur in a total environment which can be indexed (in part) by the term, "social theory."

To illustrate, it is possible that these three papers may draw (many of) their illustrations and examples from the new educational media. In addition, they are encouraged to propose partial-to-complete theoretical formulations for the new media. It is this creative extension into the area of the new media which represents the greatest challenge, the greatest potential contribution, and the most demanding aspect of these papers. At the same time, it is precisely this extension which is implied by the suggested titles, "A Learning Theory Base for the New Media," "A Social Theory Base for the New Media," "A Communication Theory Base for the New Media."

Lowest Level of Abstraction.--A third, and lowest, level of abstract-to-concrete presentation is anticipated for the fifth working paper, "The Potentials and Problems of Theory in Conducting Research and in Applying the Findings of Research." This paper is seen as being closely and directly connected to the "operational" aspects of the new media. In this sense, the paper on application becomes both an important integrating element in the Conference and a vehicle for illustrating concrete aspects of the relationships of new media and scientific theory.

The application paper is seen as drawing its examples and illustrations directly and heavily from the new media. It will address itself to the difficult problem of analyzing a two-element framework (theory potentials and theory problems) along two dimensions of application (conducting research and applying the findings of research).

Common Elements

The five working papers which have been projected, and the Conference talks based upon them, will be related and integrated (to some extent) by their common concern with scientific theory and with the new educational media. They may, of course, be even more tightly combined by exploiting the possibilities of frame of reference, organization, cross reference, parallel examples, and so on. In addition, it is suggested that, to the extent possible, the following aspects be considered as desirable common bases for the working papers and for the Conference presentations based upon them:

1. Each working paper shall treat its subject at the length and in the detail deemed necessary and sufficient by the author. It is hoped that explicit concern with clarity and generous use of graphic devices will produce an effective example of "old media" communication.
2. Each Conference presentation, breaking with tradition, shall NOT be (exclusively) a reading of the working paper. In contrast, important aspects of the working paper might be selected for analysis, emphasis, integration,

illustration, extension, and/or . . . . A total of about three hours of Conference time will be available for each presentation. This time will be divided between the talk and a discussion of it by the total Conference group and by smaller work groups.

3. Each working paper and each oral presentation shall, within the limits imposed by resources and circumstances, demonstrate effective and unobtrusive use of the principles and devices of the new media. A modest allowance has been budgeted for this purpose. Although the judgment of the author will guide the allocation, it is hoped that most of these funds will be used for the oral presentation. A relevant principle: Plan and design for the oral presentation and adapt for the working paper--rather than the other way around.

4. Unless otherwise specified, and unless more precise specification is needed, assume that the development of the oral and written presentations will be guided by the suggestions and the spirit-or-intent reflected in this document.

III. Notes on the Working Papers

Sketches, NOT Prescriptions

The three-level, abstract-to-concrete scale of treatment proposed for the working papers suggests the possibility of parallel lines of content development. One set of illustrative patterns of development is outlined in the three sections which follow.

Please note that these sketches are NOT to be construed as prescriptions. They are offered only as common starting points. It is entirely possible that alternate approaches may promise to yield more of the learning-integration-reinforcement possibilities implied by the Conference objectives.

Essence of Scientific Theory

This paper is conceived as an analysis and exposition of the essence of scientific theory. If there is merit in a particular emphasis, the area of human behavior would be a good choice. Without attempting rigid specification, and recognizing the dangers of ignorance, the following aspects of content and treatment for a three-part paper are suggested.

Nature of Theory. --The aim of this part of the paper would be to reveal-describe-illustrate the essential nature of scientific theory. Some attention might be given to "schools" of theory construction, if there are such, working toward the position to be used in the paper. If relevant and appropriate, an explanation-definition of critical elements entering into theory construction might be included. Appropriate illustrations could be drawn from many fields. If there is a choice, preference might be given to examples from human behavior--even new media.

Functions of Theory. --The aim here would be to describe, explain, and illustrate how theory functions or operates in scientific (broadly defined) reasoning. Examples and illustrations, even audience participation, might be used to reinforce critical or significant elements or aspects of operation or function. Ideally, the audience should understand, feel, appreciate the nature-power-efficiency and the general and specific appropriateness of using theory and its underlying methods.

Development of Theory. --The objective of this part of the paper would be to impart general-to-specific steps, or procedures, or processes (or whatever) which are involved in theory construction. A case example of how a theory develops is ONE relevant possibility. Another possibility would reverse this process and, starting with a theory, trace it back to its (possible) origins. Similarly, one might trace the steps in the development of an imaginary theory.

Although a three-part paper has been described, there is NO intent to imply that these three specific parts must be included-in the order suggested. What has been intended, primarily, is to indicate some possible elements of content and treatment as a means of explaining more clearly how the nature of the paper is (presently) conceived.

Learning, Communication, and Social Theory

These three papers are (presently) conceived as requiring approximately parallel treatments. It may be pertinent to note that communication theory, being closely identified with the new media, may be considered to be more concrete--by a degree or two. In general, however, these papers are seen as particular extensions of the (first) paper on theory, and as being directed toward the (final) integrating paper on the application of theory. For convenience, and with the clear understanding that modifications and improvements are sought and welcomed, the nature of these papers may be outlined as follows:

Significant Theories.--The objective of this part of the paper would be to give a descriptive history of the more significant theories. Models, theories, and other relevant constructs, if such there be, might be included. Please note that the paper might deal descriptively or analytically with "all" (a greater number) of the recognized theories. In contrast the oral presentation might concentrate on only one or two, or on some general aspect of the theories treated, or . . .

Integration and Reduction.--In this part, the general aim might be "to make some sense" out of the theories that have been advanced. An appropriate process of selection and integration seems to be indicated. Alternatively, an original creation or synthesis might be proposed. Or some aspects of a theory (or theories) might be emphasized and/or extended. The possibilities are immense.

New Media Implications.--This aspect of the papers is perceived as being the most demanding. The objective is to show how the total field outlined in the first part, narrowed through the processes of the second part, has specifiable connections or associations with the new educational media. The actual development of this part may range from the relatively simpler task of identifying connections-associations-implications to the much more demanding and sophisticated task of proposing an original theory for the new media. This proposed theory might be based (in some measure) on the reduction and integration discussion of the second part of the working paper.

It must be repeated that this three-part suggestion is to be taken more as an explanation than as a prescription. Obviously, there are many ways of bridging between theory in general and theory in a specific area such as the new educational media.

Theory in Research and Practice

The theme and purpose of this working paper and presentation is conceived as an analysis of the advantages and disadvantages of using theory in conducting research and in applying what we learn through research. In an abstract sense, the concern may be verbalized as the problem of how to use knowledge effectively and efficiently. In the Conference setting, the concern narrows to effective and efficient use of theory in new media research and practice. ONE appropriate form of the application paper is outlined below.

The Why-and-How of Using Theory. --One might project "application" references directly back to the introductory paper (even without having it for reference) by emphasizing the what, why, and how of theory use. It is possible that the frame of reference of this paper may require adjustments in the presentation in order to take advantage of unanticipated relationships with the paper on theory. Without specifying intermediate steps, one might move to the general conclusion that theory provides a basis for effective and efficient use of what we know and for effective and efficient seeking of that which we do not know.

Theory in Planning and Conducting Research. --The general goal is seen as being that of highlighting, explaining, and demonstrating how theory can be used in the research process. Appropriate examples and illustrations from real or contrived studies of the new educational media might be used. Both positive (advantages) and negative (disadvantages or dangers) potentials could be considered.

A critical element in the Conference setting will be the selection of significant points for oral presentation. The suggested relationship between the working paper and the Conference presentation suggests that the oral presentation could be more limited and more selective with respect to content. Some of the (second order) omitted elements would surely come out in the large and small group discussions. . . .

Theory in Applying Research Results.--This highly generalized (and major) concern is conceived as centering on the problem of effective and efficient (rational? or intelligent?) application of that which we know. In the Conference setting, the specifics of "practical application" and "what we know" relate directly to the new media. This relation might be reinforced by drawing illustrations from research on the new educational media, and reinforcing them in the oral presentation by appropriate use of new media principles and devices. Not to be overlooked here, nor in the other presentations, is the possibility of audience participation in these illustrations and demonstrations.

The application presentation, perhaps in its summary or conclusion, might try a rather "complete" analysis of the research-practice dilemma. The oral presentation could select, illustrate, and integrate the more significant points made in the working paper. The suggested summary could be related both generally and specifically to elements of the other papers and presentations. This (final) presentation might thus serve as an important summarizing and integrating element for the Conference as a whole.

Again, it must be noted that the foregoing comments are offered more as explanations than as prescriptions.

Use of Working Papers

It is anticipated that, in addition to personal use by the author, the working papers will be available for use by the United States Office of Education under its usual grant provisions. Specifically, the working papers will be:

1. Reproduced in a briefing manual for pre-Conference use by participants; and,

2. Published in the final report of the Conference.

Any additional use of the papers will be cleared with the authors. On the latter point, there is a possibility that the working papers, plus the Work Conference Group reports, plus subsequent additions and revisions, may add up to the content of a major publication. This possibility has been advanced, and the Office of Education has recognized it to the extent of writing in a to-be-negotiated-at-a-later-date provision in the Conference contract. If the Conference report should indicate that a more sophisticated publication is warranted, the authors will be approached for appropriate clearance and assistance.

IV. Operational Review

Time Schedule

Taking into account the availability of people and facilities, the dates of related professional meetings and, most importantly, the need for time in which to prepare, yielded the following time schedule:

January 1: Deadline for submitting manuscripts of the working papers. This date allows for duplication and distribution to Conference participants early in February.

January 15: Deadline for submitting specifications for "new media" presentation materials to be prepared at Michigan State University. There may be greater leeway if these materials are prepared locally under the supervision of the author.

March 11-15: Dates of the Work Conference at the Kellogg Center for Continuing Education, Michigan State University. A final Conference program will be available by January 15.

Check Point

A greater measure of unity among the working papers and presentations can be achieved through pre-Conference review. A visit with each author early in the development of the manuscript is one possibility. Another possibility, probably more desirable, is a meeting of the authors some time before the working papers are committed to paper. Alternate times which have been suggested include late August, when the working papers will probably be in rough outline form; or late September or early October, when the papers might be at a more definite stage of development. It seems prudent to suggest that this meeting be called as early as possible, and that it be held at a place where the burden of travel will be about equally divided among those involved.

This matter is being left open. An acceptable arrangement will be worked out with the authors. Whatever is finally agreed upon, we are offering to reproduce and to exchange outlines and drafts of manuscripts among the authors.

Additional Commitments

In addition to preparing the working papers, the authors are being asked to cooperate on the matters indicated below. It is assumed that any emergencies not anticipated will be considered on their merits. The additional commitments are:

1. Take responsibility for supervising the preparation of the "new media" aids to be used in the oral and written presentations.
2. Grant permission for reproducing these aids for use by the Office of Education and the sponsors of the Conference.
3. Make the presentation at the Work Conference and be available to the discussion groups as a consultant or resource person for at least one day--preferably for the whole Conference period.

4. Take part in a review of the Conference presentations. The arrangements for this review will be worked out with the authors--as suggested in the preceding section.

Honoraria and Expenses

The Office of Education grant provides a modest allowance to cover both the costs of planning and preparing materials and the costs attending the Work Conference itself. For the resource people, the specific items are:

1. An honrarium of $500.00 for each of the people preparing working papers and making oral presentations at the Conference.
2. An allowance of $450.00 to cover the costs of graphic, "new media" presentation materials.
3. Travel and subsistence expenses in connection with meetings to review and integrate the major papers and presentations.
4. Travel and subsistence expenses to the Work Conference.

The budget for this project has not been padded. Consequently, any flexibility which may be required will be provided for under the "additional costs" clause of the Office of Education contract. This fact should NOT discourage additional expenditure if it promises to strengthen the Conference. Suggestions about how to improve and to strengthen the Work Conference are most welcome. We are confident that the Office of Education will take a reasonable position on matters of this kind.

V. Summary

We can believe that some of the problems of written communication can be avoided by emphasizing the major elements of this lengthy and involved "prospectus." In offering this summary, we are asking each resource person to accept the following commitments:

1. To develop a creative, professional working paper on the subject in question, guided by the spirit and the intent of the suggestions of this document.

2. To supervise the development of suitable presentation procedures and materials which will help to make the Conference presentation (and the working paper) an unobtrusive demonstration of the new media theme underlying the Work Conference.

3. To take part in a pre-Conference meeting and/or in other activities designed to assure an effective, integrated series of working papers and Conference presentations.

4. To attend the proposed Work Conference for the whole session--preferably. At a minimum, to schedule the day of the oral presentation for consulting with the discussion groups.

5. To grant permission to reproduce the working paper in a document designed for pre-Conference briefing of participants and in the formal project report for the Office of Education.

6. To grant permission to prepare duplicates of the oral presentation materials for possible use by the Office of Education and the sponsor of this project.

Finally, we wish to state again that this document is NOT intended to be a legal instrument. It tries to specify and to illustrate, in some detail, some aspects of our initial thinking. We expect and sincerely invite any suggestions which promise to strengthen the Work Conference.

Appendix E

Conference Working Documents

The documents in this appendix were selected to illustrate the direction, structure, process, and produce dimensions on the Theory Conference. They represent some of the major (written) attempts to realize the unique potentials of the conference method. Preceding each document are brief notes (in brackets) which explain the nature and use of each document, and the changes made to facilitate reproduction. The documents reproduced are: (1) participants' reaction form; (2) questions, reminders, and notes; (3) the Conference program; (4) work-discussion group assignments; (5) organizing work-discussion groups; (6) work-discussion group processes; (7) dimensions of group discussion; (8) cogitations-observations-comments; and (9) suggestions for work-discussion group reports.

Item 1: Participant Reactions

[The actual, one-page form (on pink paper) provided space for answers. Only the questions are reproduced here. Note, too, that the questions relate only to the first working paper. Different questions were prepared for each of the five pre-Conference working papers. The content of the questions was determined by the concerns of the author, early feedback from participants, and by the general requirements of the proposed evaluation.

To provide participants with a copy of the reactions submitted, a sheet of carbon paper and a duplicate of the reaction form were bound into each working paper booklet immediately following the original form. A stamped, self-addressed reply envelope was clipped to the reaction pages. It thus served the additional purpose of a bookmark.]

PARTICIPANT REACTIONS

PLEASE ENTER your questions and comments about this working paper, REMOVE the page, and RETURN it to us in the stamped and addressed envelope provided.

1. Please indicate the concepts, processes, or other elements of this working paper which you find need additional clarification or other treatment to help convey a more complete understanding of their essential nature and potential.

2. Please indicate additional subject matter which you suggest would help this working paper to fulfill its Conference role.

3. Please add any thoughts which you believe would help to strengthen this part of the Conference.

If you wish, please sign ______________________________

Item 2: Questions, Reminders, and Notes

[In use, "Questions and Reminders" was a single-page, white paper form which was bound into the working paper booklets following the (pink paper) "Participants' Reactions" forms. The intent was to provide a stimulus for individual questioning and analysis in the form of a list of key words/concepts taken from the working paper in question.

Following this item (in each working paper) was another single-page form headed, "Questions-Notes-Reminders." This form, printed on white paper, provided space for additional notes--on the basis that "Questions and Reminders" might have provided too much structuring.

Both "Questions and Reminders" and "Questions-Notes-Reminders" were offered so that participants could record items which they could bring up at the Conference. Although the content varied from paper to paper, they were all constructed on essentially the same principles. The examples following are taken from the first working paper.]

QUESTIONS AND REMINDERS

Please use this page for notes on ideas that occur as you read-and-study this working paper. The random list of words below may help to "trigger" a "shot of thought" . . .

Clarification
Explanation
Demonstration
Adaptation
Relation
Extension
Omission
Situation
New Media
Education
Human Behavior
Society
Planning
Testing
Applying
Ordering

QUESTIONS-NOTES-REMINDERS

. . . If the "directiveness" of the preceding page "jarred," please let yourself go on this page. . . .

Item 3: Conference Program

[The Conference program was prepared as an inexpensive, mimeographed, 14-page booklet measuring 4-1/4 by 9 inches. An orange cover, carrying a simple design, made it visually attractive--but not, it is hoped, to a degree which implied that its significance was equal to, or greater than, the significance of that which it indexed.]

SUNDAY, MARCH 11--Afternoon

3:00 - 6:00--REGISTRATION, Conference Desk, Lobby

6:00 - 8:00--BUFFET SUPPER AND SOCIAL HOUR, Centennial Room

MONDAY, MARCH 12--Morning

8:30 - 10:00--CONFERENCE ORIENTATION, Lincoln Room A & B

Dr. Clifford E. Erickson, Provost, "Welcome to Michigan State University"

Conference Plans: Questions and Discussion

Coffee in Cafeteria

10:00 - 12:00--SESSION I, Lincoln Room A & B

Dr. Richard S. Rudner, Michigan State University, "Structure and Function of Scientific Theories"

Moderator: Dr. David R. Krathwohl, Michigan State University

Questions, Comments, Discussion

12:00 - 1:30--Lunch, Centennial Room

MONDAY, MARCH 12--Afternoon

1:30 - 3:30--SESSION II, Lincoln Room A & B

Dr. Frank A. Logan, Yale University, "Learning-Behavior Theory and Education"

Moderator: Dr. Richard I. Evans, University of Houston

Questions, Comments, Discussion

Coffee in Cafeteria

3:30 - 5:00--WORK GROUP SESSIONS

Group A: Lincoln Room A
Group B: Lincoln Room B
Group C: Room 101
Group D: Room 106
Group E: Room 107
Group F: Room 110
Group G: Heritage Room

6:00 - 7:30--Dinner, Centennial Room

Dr. James Tintera, Michigan State University, "Laboratory Work in Reading with Handicapped," film and discussion

TUESDAY, MARCH 13--Morning

8:30 - 10:30--SESSION III, Lincoln Room A & B

Dr. Erwin P. Bettinghaus, Michigan State University, "Communication Theory and the Use of the New Media"

Moderator: Dr. Malcom S. MacLean, Michigan State University

Questions, Comments, Discussion

Coffee in Cafeteria

10:30 - 12:00--WORK GROUP SESSIONS

[Same room assignments as for the Monday sessions]

12:00 - 1:30--Lunch, Centennial Room

TUESDAY, MARCH 13--Afternoon

1:30 - 3:30--SESSION IV, Lincoln Room A & B

Dr. Morris Janowitz, University of Chicago, "Social Theory and the New Media"

Moderator: Dr. Wilbur B. Brookover, Michigan State University

Questions, Comments, Discussion

Coffee in Cafeteria

3:30 - 5:00--WORK GROUP SESSIONS

[Same room assignments as for morning sessions]

6:00 - 9:00--Dinner at Dines, Beaumont Room

[Buses leave main entrance of Kellogg Center at 6:00. Dinner at 7:00. Buses return to Kellogg Center, 8:45 - 9:00.]

WEDNESDAY, MARCH 14--Morning

8:30 - 10:30--SESSION V, Lincoln Room A & B

Dr. Henry Bern, Indiana University, "Implications of Theory for Research and Implementation in Educational Media"

Moderator: Dr. Nicholas A. Fattu, Indiana University

Questions, Comments, Discussion

Coffee in Cafeteria

10:30 - 12:00--WORK GROUP SESSIONS

[Same room assignments as for earlier sessions]

12:00 - 2:00--Lunch, Centennial Room

Panel of Resource People, "Second Thoughts, Impressions, and Postscripts"

[Informal, round-table discussion by the resource people focused on the five major presentations, and extended to related Conference experiences and observations.]

WEDNESDAY, MARCH 14--Afternoon

2:00 - 3:00--SESSION VI, Lincoln Room A & B

Dr. John M. Parsey, Conference Director, Michigan State University, "Nature of Work Group Reports"

Purposes, Content, Potential
Questions, Comments, Discussion

Coffee in Cafeteria

3:00 - 5:00--WORK GROUP SESSIONS ON REPORT

[Same room assignments as for earlier sessions]

6:00 - 7:30--Dinner, Centennial Room

Dr. James Tintera, Michigan State University, "Heredity," audience-participation selection from a scramble book by Dr. Mary Alice Burmeister, University College, Michigan State University

7:30 - 8:30--WORK GROUP SESSIONS ON REPORT

[Same room assignments as for earlier sessions]

THURSDAY, MARCH 15--Morning

8:30 - 10:30--SESSION VII, Lincoln Room A & B

Work Group Reports by Groups A, B, C, and D

Moderator: Dr. John M. Parsey, Conference Director, Michigan State University

Questions, Comments, Discussion

Coffee in Cafeteria

10:30 - 12:00--Continuation of SESSION VII, Lincoln Room A & B

Continuation of Work Group Reports: Groups E, F, and G

Questions, Comments, Discussion

12:00 - 1:30--Lunch, Centennial Room

THURSDAY, MARCH 15--Afternoon

1:30 - 3:00--CLOSING SESSION, Lincoln Room A & B

"Conferencation"

Moderator: Dr. John M. Parsey, Conference Director, Michigan State University

Questions, Comments, Discussion

Coffee in Cafeteria

3:00 ---- Adjournment

[The Conference program ended with several lists of names: the Conference Resource People, the Regional Advisory Committee, the Title VII Conference Committee--plus several emergency addresses and telephone numbers. The names are listed in Appendix F.]

Item 4: Work-Discussion Group Assignments

[Conference plans called for work groups of 10 to 15 people. Assignment to groups was at random, based on the chance order of arrival and registration. The name of one participant was picked by lot. This person, A1, became the first member of Group A. The person, B1, whose name followed that of A1 on the registration list, became the first member of Group B. Similarly, the person, C1, whose name followed that of B1, became the first member of Group C . . . and so on, in rotation, for the others.

In the group lists given below, the names of the group reporters are starred (*). In total, there were 58 active participants--five groups of eight members each, and two groups of nine. Counting consultants and resource people, but not the casual visitors, gives a total attendance of 70. Checks on the stability of groups indicated that, almost without exception, the participants remained with the groups to which they had been assigned initially. In fact, only two persons were found to have changed groups.]

GROUP A

Leon Alger, John Barson, Frank Byrnes, Theodore Clevenger, Desmond Cook*, Bart Griffith, Wayne Howell, Joseph Stokes.

GROUP B

John Bicknell*, Gerald Gleason, Lincoln Hanson, Craig Johnson, Carl Lefevre, Henry Milanowski, Warren Seibert, Mrs. Naomi Witesell.

GROUP C

Clarence Boeck, Paul Brimm, John Buelke, Richard Lawrence, Dale McDowell, Clyde Miller, Neville Pearson*, Robert Suchy.

GROUP D

Arthur Carpenter, Robert Dixon, W. W. Kemmerer, Wesley Meierhenry, Mrs. Leona Probst, Robert Tiemens*, Ralph Tindall, Loran Twyford.

GROUP E

William Engbretson, Paul Heinberg*, Robert Kilbourn, Daniel Neale, Lawrence Siegel, Robert Wheeler, John Withall, Myron Woolman.

GROUP F

Robert Kern, James Knowlton, Donald Lloyd, Mrs. Ann Paterson, John Paterson*, Harvey Schmidt, Robert Snider, James Tintera, Roy Wenger.

GROUP G

Richard Evans, Jan Gyswyt, John Montgomery, Chandos Reid, Gordon Rhum, Frank Slobetz, M. Daniel Smith*, Fred Williams.

Item 5: Organizing Work-Discussion Groups

[This one-page document, mimeographed on blue paper, was distributed to participants following the second general session--see Conference Program, Item 3, above. The distribution was preceded by a period of explanation and discussion.]

I hope that you will accept the suggestions which follow in the same spirit as that of our recent discussion. This document does little more than to provide a convenient record of the major points which we considered. The intent is to get the work groups working--as quickly and as easily as possible.

To organize your group, about all that you will need is a chairman and a recorder. Name these officials by choosing from the alternatives below, or work out a procedure that you like better. . . .

1. The fourth person on your group list, or the person nearest to the door, or a volunteer, or . . . is responsible for getting your group organized.
2. Elect, or recruit, or conscript a chairman, or rotate the position, or . . .
3. Use the same procedure as in #2 to designate a recorder.

To facilitate your deliberations, and to provide a record to which you can refer--and which others will be able to share--consider these suggestions and possibilities:

1. Keep topical notes, or something equivalent, which will reflect the content, direction, and flavor of your deliberations. You will find a loose-leaf notebook for this purpose among the materials in your meeting room.
2. Please ask for help with typing and/or duplicating. Session summaries, outlines, statements of position, important conclusions or recommendations, etc., etc., can be typed and/or duplicated in time for your next group session.
3. Note that equipment and materials have been provided for your meeting room. Use them as comes naturally. . . . Please ask for any additional items that you may need.
4. The resource people will be happy to meet with any group. When "unassigned," they will move from group to group. Please contact them directly; or give your request to Miss Mary Carew, John Parsey, or Henry Milanowski; or call Extension 5-0140.

Item 6: Work-Discussion Group Processes

[This one-page document, mimeographed on pink paper, was distributed at the same time as Item 5, above. It summarized the process aspects of the total-group discussion which preceded it. Its purpose is to document (reinforce) major aspects of the preceding ends-and-means discussion.]

During the general session, particular consideration will have been given to these matters:

1. The purposes and the structure of the Conference;
2. The nature, the interrelationships, and the implications of the major presentations;
3. The purpose, role, and structure of the work-discussion groups; and
4. The availability, now and throughout the Conference, of what--we hope--are, and will be, genuine aids to group deliberations.

At this time, and throughout the Conference, we are striving for an atmosphere of genuine, dynamic informality. Frankly, we are willing to sacrifice some of the personal satisfactions of group dynamics on the altar of intellectual creativity and professional productivity--and with no more than minimal regard for personal preferences and individual idiosyncrasies. We shall be striving to develop an atmosphere which will favor a cooperative effort of this kind. These concerns, and the pressure of time, prompt us to propose that the work-discussion groups operate, at least initially, within a framework provided by:

1. The purposes of the Conference,
2. The pre-Conference working papers, and

3. The major Conference presentations and discussions--as these are covered in our schedule.

Please remember that all of us "at home" folks see our role as being, quite clearly, the minor one of facilitating the development of that which you regard as important. As a result, we offer all suggestions as such--and no more! Our aim is to stimulate group and individual processes which are broad in range and creative in nature. We do not wish to dictate, nor to limit the dimensions of your deliberations.

Item 7: Dimensions of Group Discussion

[This document was designed to give minimum structure to the group discussions, and to encourage breadth, variety, and creativity. The nature and purposes of the work-discussion group sessions have been considered before this outline was distributed (see Items 5 and 6, above). The content which follows illustrates elements of both the structured and the more permissive framework of the group sessions.]

This outline is offered to encourage and to stimulate groups to add dimensions to their deliberations. It is being distributed about mid-way through the Conference because, at that point, its potential for over-directing and over-limiting group discussion will be much reduced. Moreover, it cannot be said that it contains anything really new. It merely illustrates another application of the basic ideas which have been repeated many times during the Conference.

Please note that the outline is not, in any sense, a directive. It is merely a stimulus. In a rather pedestrian way, it suggests areas which you may wish to explore. More important, it may stimulate you to identify and to explore completely new and different dimensions.

Note also that the outline which follows suggests four possible directions for your deliberations. There are, of course, many more directions which can be read into, or read out of, the stated purposes of the Conference. . . .

1. Content of the Conference. -- The formal, complete title of the Conference is, "Regional Work Conference on the Role of Theory in Planning and Conducting Research and in Applying the Findings of Research on the New Media in Education." It's a long title. However, it does reflect the theme and the organization of the Conference. The key terms and concepts are:

a. Work conference

b. Role

c. Theory

d. Planning and conducting research

e. Applying the findings of research

f. Education

g. New Media

Directly or indirectly, by extension or by projection--or in other ways, these terms and concepts may suggest subjects for your consideration. For example, the combinations ABC (work conference, role, theory); BC (role, theory); DE (planning and conducting research, applying the findings of research); and FG (new media, education) may suggest areas, issues, or problems which you may wish to consider. To verge on specification: WHAT can be done to STRENGTHEN (develop, improve, etc.) WHAT relationships in this area? WHO should be responsible for the task? WHEN should it be done? HOW might (should) it be done?

2. Purposes of the Conference. -- The purposes of the Conference can suggest many lines of exploration. To repeat the purposes:

a. To explore the nature and potential of a theoretical base for media research and application; and

b. To experiment with conference planning and programming;

c. To develop, as an extension of the Conference report, a significant publication on the role of theory in new media research and application.

To illustrate, the first and third purposes may be interpreted as specifying goals or ends totally within the operational area of the Conference. Thus the work-discussion group may direct all its attention to matters such as those suggested by the following questions: HOW does (should, ought, etc.) THEORY relate to RESEARCH and APPLICATION? WHAT might be done to CLARIFY (or improve, establish, develop, etc.) these relationships? HOW might this TASK be carried out? WHO should (ought, might, etc.) assume leadership in carrying out this task? WHEN should this TASK be started?

3. Possibilities of the Conference Structure. -- The major structural elements of the Conference are:

a. Scientific theory--nature, function, development;

b. Learning theory;

c. Communication theory;

d. Social theory; and,

e. Potentials and problems of theory for the new media in: (1) planning and conducting research, and (2) applying the findings of this (and other) research.

One or more of the preceding structural elements can suggest many subjects for your consideration. For example, using the Conference objectives as a framework, the elements of structure can yield questions such as: WHAT potentials of THEORY are not being fully realized in new media RESEARCH and APPLICATION? HOW can WHAT additional areas of the SOCIAL SCIENCES contribute to new media RESEARCH and APPLICATION? HOW do the SOCIAL and PHYSICAL sciences differ in recognizing the

ROLE of theory--in RESEARCH and in professional APPLICATION of the results of research? HOW might the Conference STRUCTURE be altered to provide greater progress toward the accepted goals?

4. Additional Possibilities.--Again, within the limits of Conference purposes, other subjects for group consideration may be derived from elements such as: the working papers, the major presentations, the significant questions raised during the general sessions, and the notes and reminders which you brought to the Conference.

Do not overlook the possibility of addressing suggestions and recommendations about any aspect of this Conference to the group which planned it, to the Office of Education which sponsored it, or to the new media and social science professions which are involved in it. Moreover, you might choose to address some of your efforts to Conference evaluation--both in terms of what it was and in terms of what it might have been. . . .

Item 8: Cogitations-Observations-Comments

[This document was designed to obtain continuing feedback during the Conference. It was a one-page form, mimeographed on yellow paper. Each participant received several copies, and a supply was available in each meeting room. The form asked participants to report on events and other during-the-Conference developments in terms of: (1) what happened, (2) what effect it had on the Conference, and (3) what might be done to overcome negative effects. Aside from its value in relieving personal tensions of some participants, the form also provided information for making program adjustments and data for analyzing Conference process. A sample of a completed form is reproduced below.]

COGITATIONS-OBSERVATIONS-COMMENTS

What Happened?	What Effect?	What To Do?
A professor of speech just made what I considered to be an unjustified criticism of programed instruction. He was not one of the consultants, he was a participant.	I had no way of knowing the level of sophistication underlying his criticism.	Is it possible to prepare more complete biographical sketches of participants? They could be submitted by participants in order to help each one to assess the contributions of others in terms of experience and orientation.

Item 9: Suggestions for Work-Discussion Group Reports

[This two-page document was distributed following a general session discussion of the nature of the work-discussion group reports. It covered the major points discussed, and served as a ready reference as the work groups prepared their reports. The reports are cited in full in Part IV of this report.]

The suggestions which follow are NOT to be taken as directives. They merely present a framework on which to hang a summary of your deliberations. The framework has only four elements. If your report does not fit the framework, you may wish to make adjustments. On the other hand, you may choose to develop another structure which may (better) serve present purposes. Most importantly, please note that the suggestions which follow specify minimums. You are, of course, encouraged to go as far beyond them as you judge to be prudent.

Please note that the purposes of the Conference specify the framework for the reports:

1. To explore the nature and potential of a theoretical base for new media research and application;
2. To experiment with conference planning and programing; and
3. To develop, as an extension of the Conference report, a significant publication on the role of theory in new media research and application.

Within this framework--and noting that the reports can be modified, or extended, or supplemented--this possible organization of the work-discussion group reports is offered:

1. A first section might bring together items from the work group's discussions which are rather directly concerned with the content and organization of the Conference itself. The content might include a critical analysis of the Conference, the identification of program strengths and weaknesses, and suggestions for changes in emphasis. Both generally and specifically, address the report to ways and means of strengthening new media research and application within the framework of Conference purposes. This part of your report should be directed to the groups which developed the Conference.
2. A second section of your report might focus upon broader or more general ways of strengthening new

media research and application. That is, in contrast with the first section, it might focus more on the total project than on the Conference itself. Thus this section would examine the total venture of which the Conference is but a part--both within and outside of the framework of Conference purposes. The suggestions, observations, and recommendations of this section will be addressed to research people and to professional practitioners in new media and related fields.

3. A third section might include thoughts, suggestions, observations, and recommendations addressed specifically to ways and means of strengthening new media research and application by disseminating relevant knowledge (subject matter or content). It will be directed to the United States Office of Education which cooperated in sponsoring this Conference. The purpose here will be to indicate what this agency might do to strengthen new media research and application.

4. Finally, a fourth section might be included in the report. This section encourages each group to record and to share unique and imaginative products and experiences of its discussions. It might deal with matters such as observations and comments for the general good of research and application, and recommendations to the new media and social science professions concerning the role that such professional groups and individuals might play in developing a more scientific basis for their work.

Appendix F

Participants in the Theory Conference Project

This appendix identifies all of the people who played significant roles in the development of the "Regional Work Conference to Explore the Potentials and Problems of Theory in New Media Research and Application." The listing of names cannot express an adequate and appropriate degree of appreciation for the professionally motivated, highly creative, and numerous contributions which were made. It can, perhaps, only index such appreciation and identify the people who share it. The lists which follow duplicate names of people who served in more than one capacity.

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